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OF THE

UNITED STATES

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1889 AND 1890

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY

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LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF MINING STATISTICS AND TECHNOLOGY,
Washington, January 23, 1892.

SIR: I have the honor to transmit herewith the seventh report of the series "Mineral Resources of the United States," this volume being entitled "Mineral Resources of the United States, 1889 and 1890." The first report of the series gave account of the mineral products of 1882 and part of 1883, and the subsequent volumes bring the statistics to December 31, 1888. The present volume carries the statistical data to December 31, 1890. A report covering the year 1891, which you have authorized, is in active preparation.

I beg to tender you my hearty appreciation for the consideration you have shown to my very considerable demands on your time and attention and for your untiring interest in this work.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

Hon. J. W. POWELL,
Director, U. S. Geological Survey.

INTRODUCTION.

The present volume of the series "Mineral Resources of the United States" presents a review of the mineral industries during the calendar years 1889 and 1890. It is in continuation of the previous volume which covered the year 1888. During part of the years 1889, 1890, and 1891 the several contributors to this series were nearly all of them engaged in preparing the volume on the mineral industries for the Eleventh Census. The statistics here presented for 1889 are therefore those of the Census Office, with a few minor exceptions. These exceptions are the cases in which the mineral report for the Census Office did not consider certain industries which are usually included in the reports of this series. The statistical tables of former years have been carried forward, but the previous volumes should be consulted for all other information concerning the mineral industries prior to 1889.

The scope of the present volume has been lessened slightly in the effort to make the arduous work of complete statistics from all producers more accurate in the subjects of coal, iron ores, and other important subjects.

Units.—The different units adopted are those in common use for each mineral. Pounds are avoirdupois and tons are short tons of 2,000 pounds, unless long tons of 2,240 pounds are specified.

Imports and exports.—These are obtained from the records of the Bureau of Statistics of the Treasury Department. Recent years coincide with calendar years from January 1 to December 31, but earlier statistics of imports are for the Government fiscal year ending June 30.

Delay in publication.—It has already been shown in previous volumes that it is impossible to gather complete reports on so many subjects and publish the resultant volume without much delay, since one report can delay all the rest, and this is especially the case in proportion as the inquiries are extended to individual producers. Efforts have been made, however, to avail of the daily and technical press in giving information regarding each subject as promptly as possible.

Totals.—In preparing the statement of the total value of the mineral product, the usual commercial value has been taken. Following the rule adopted in the Census investigation, the value of a mineral is taken at that stage in its production where it first becomes a salable article with a market value recognized in its trade. Thus, coal is valued on cars at the mine, while lead is given its value in New York City. Any valuations which might be adopted would involve inconsistencies, but this plan is best in accordance with ordinary usage.

The product indicated for 1890 is $656,604,698, an increase far beyond any previous year. The year was a period of unexampled activity in mining, particularly so in iron, silver, copper, coal, and petroleum. This total is extraordinary, but the activity continued in 1891 until checked by the feeling of insecurity following the English depression. The year 1891 will show no marked contrast to 1890.

MINERAL RESOURCES OF THE UNITED STATES.

SUMMARY.

METALS.

Iron and steel.—The production of pig iron in the United States in the year 1889 was 7,603,642 long tons, or 8,516,079 short tons, valued at $120,000,000, taking as the standard of valuation the price of No. 1 anthracite pig iron in Philadelphia. This was greater than the product of any previous year; but in 1890 the product increased greatly, reaching 10,307,028 short tons, valued at $151,200,410, and in 1891, 9,273,455 short tons. The production of Bessemer steel in the United States in 1890 was 4,131,535 short tons, against 3,281,829 short tons in 1889, a gain of nearly 26 per cent. The consumption of limestone for flux in iron ore smelting was 5,521,622 long tons in 1890.

Gold and silver.—In 1889 the mines of the United States produced, according to the census returns, 1,590,869 fine ounces of gold, with a coinage value of $32,886,744, and 51,354,851 ounces of silver, with a coining value of $66,396,988. In 1890 the product, according to the Director of the Mint, was: Gold, 1,588,880 ounces, valued at $32,845,000, and silver, 54,500,000 ounces, with a coining value of $70,464,645.

Copper.—The copper product remained nearly stationary in 1889, being 231,246,214 pounds, and in 1890 increasing to 265,115,133 pounds. It was worth, respectively, $26,907,809 and $30,848,797.

Lead.—The total product increased in 1889 to 182,967 short tons, worth $16,137,689, compared with 180,555 short tons in 1888, worth $15,924,951. In 1890 the product decreased to 161,754 short tons, worth $14,266,703. The producers carried a stock of 10,389 short tons on January 1, 1891, as compared with 7,715 short tons on January 1, 1890. The lead content of the ores imported from Mexico was 26,570 tons in 1889, and 18,124 tons in 1890. The production of lead in the first half of 1891 increased to 95,121 short tons.

Zinc.—In 1888 the total product of spelter was 55,903 short tons, worth $5,500,855. In 1889 it increased to 58,860 short tons, worth $5,791,824, and in 1890 to 63,683 short tons, worth $6,266,407. The stocks in the hands of producers are small, considering the magnitude of the industry. On January 1, 1890, these stocks were 2,535 short tons, and on January 1, 1891, had decreased to 1,134 tons.

Quicksilver.—The industry continues to decline in spite of active prospecting for new supplies. In 1888 the product was 33,250 flasks of 76½ pounds net, valued in San Francisco at $1,413,125. In 1889 this declined to 26,484 flasks, although the price was $45 per flask, which was sufficient to cause strong inquiry for new supplies. In 1890 the product decreased to 22,926 flasks, the average price increasing to $48.33 per flask. The product all came from California.

Nickel.—During the years 1889 and 1890 the condition of the industry changed completely, due to the development of extensive supplies in Canada. The inquiry for still other new deposits was nevertheless stimulated by the successful tests of steel containing a small percentage of nickel for armor plates. Previously the markets were regulated principally by the output of the New Caledonia mines. In 1888 the total product in the United States was 204,328 pounds. In 1889 this increased to 252,663 pounds and in 1890 to 223,488 pounds, worth $134,093. The product from Canadian matte was 35,000 pounds in 1889 and 100,000 pounds in 1890.

Cobalt oxide.—The product has followed the nickel industry, except that proportionately more nickel has been produced than cobalt oxide, because the Canadian matte contains scarcely any cobalt. The New Caledonian producers have produced a greater proportion of cobalt by the aid of a manganiferous iron ore containing nickel and cobalt. The product in 1889 was 13,955 pounds and in 1890 6,788 pounds. The price remained at about $2.50 per pound in 1889 and $2.40 in 1890.

Chromic iron ore.—The industry remains unchanged. The supplies come from California, together with increasing importations from Turkey and Asia Minor. The output in California in 1889 was 2,000 long tons, and in 1890 3,599 long tons, worth $53,985.

Manganese.—Product in 1889, 24,197 long tons, which includes a small shipment from Colorado. In 1890 the product was 25,684 long tons, worth $219,050. The importations are increasing. In addition, manganiferous iron ores were produced to the amount of 83,434 tons in 1889 and 61,860 tons in 1890.

Aluminum.—The production of aluminum, including that in alloys, continued and increased from about 19,000 pounds in 1888 to 47,468 pounds in 1889, and 61,281 pounds in 1890. The price decreased from $4.50 per pound in 1888 to $1 per pound in 1890 for ingots. The manufacture of aluminum into musical instruments, thin sheets for ornamental purposes, and into various utensils is increasing.

Antimony.—In 1889, 115 short tons were produced, valued at $28,000; in 1890 this increased to 129 short tons, valued at $40,756. This included a slight product from a new source, Ketchum, Idaho,

FUELS.

Coal.—In 1889 the total product of coal of all kinds was 141,229,513 short tons, valued at the mines, before any expenses for shipment, at $160,226,323. The product included 45,600,487 short tons of Pennsylvania and other anthracite, worth $65,879,514, and 95,629,026 short tons of bituminous coal and lignite, valued at $94,346,809.

In 1890 the total product increased to 157,788,657 short tons, a gain of over 4½ per cent. over 1889. The total value at the mines was $176,804,573. Of the above, 46,468,641 short tons were anthracite, worth $66,383,772, and 111,320,016 short tons were bituminous coal and lignite, worth $110,420,801.

Petroleum.—The product in 1889 was 35,163,513 barrels, valued at $26,963,340. In 1890, the product was 45,822,672 barrels, worth $35,365,105. The feature of the two years has been the successful refining of Lima (Ohio) oil, which now supplies a large share of the domestic trade, and the great increase in the Pennsylvania product in 1890, making this the year of greatest product.

Natural gas.—The product, measured in terms of the coal displaced, shows a decline from $22,629,875 in 1888 to $21,097,099 in 1889. The product declined again in 1890 to $18,742,725.

STRUCTURAL MATERIALS.

Building stone.—The product in 1889 includes granite to the value of $14,464,095, at the place where produced and in the condition in which it was first sold; marble, $3,488,170; sandstone, $10,816,057; bluestone, $1,689,606; limestone, $19,095,179; and slate, $3,482,513. In 1890 the total value of these products aggregates $54,000,000. Even allowing for a considerable growth in the industry since 1888, these figures show that the statement then made was too small.

ABRASIVE MATERIALS.

Millstones.—The product continued to decrease. In 1889 the product was valued at $35,155, and in 1890, at $23,720.

Grindstones.—The supply still comes from Ohio and Michigan. The consumption has increased in grinding wood pulp. The product in 1889 was valued at $439,587, and in 1890, at $450,000.

Oilstones and whetstones.—This industry derives its supplies from well established quarries in Arkansas, Indiana, and New Hampshire. In 1889 the product amounted to 2,354,000 pounds, chiefly novaculite, and valued at $32,980. In 1890 the value of the product was $69,909 in the rough state.

MISCELLANEOUS.

Precious stones.—The product is small and with the exception of agatized wood, the tourmalines regularly produced in Maine, and a few gems from North Carolina, consists principally of tourists' jewelry. It was valued at $188,807 in 1889 and $118,833 in 1890.

Phosphate rock.—In 1889 the production of phosphate rock was established as a new industry in Florida and its importance is increasing. The total product from all sources amounted to 550,245 long tons in 1889, which was the greatest amount ever reported. In 1890 the product was 510,499 long tons, worth $3,213,795.

Marls.—The product in 1889 was 139,522 short tons, worth $63,956, and in 1890, 153,620 short tons, worth $69,880. There is little change in the industry.

Salt.—Product in 1889, 8,005,565 barrels, worth $4,195,412, and in 1890, 8,776,991 barrels, worth $4,752,286.

Bromine.—The product in 1889 was 418,891 pounds, valued at $125,667. In 1890 this decreased to 387,847 pounds on account of the accumulation of stock.

Borax.—In 1889 the product was 8,000,000 pounds worth $500,000, increasing in 1890 to 9,500,000 pounds.

Sulphur.—In 1889 and 1890 the Utah works were closed by litigation. There was a small product from the Nevada mines in 1889, amounting to 1,150 short tons. Efforts are being made to open the Louisiana mines.

Pyrites.—The product from Virginia, Massachusetts, and Vermont amounted to 93,705 long tons, worth $202,119 in 1889, and in 1890 to 111,836 long tons, worth $273,745.

Barytes.—The use of this material is increasing. The main sources of supply are mines in Missouri, Virginia, and New York. The total product in 1889 was 19,161 long tons and in 1890, 21,911 long tons.

Gypsum.—In 1889 the product was 267,769 short tons of crude gypsum, worth $764,118, and in 1890, 182,995 short tons, worth $574,523.

Ozocerite.—Development work was continued in the regions near Soldier's Summit, Utah; 50,000 pounds were produced in 1889, and 350,000 pounds in 1890.

Asphaltum.—During the last two years the product on the Pacific coast has increased markedly and the price has declined. Product in 1889, 51,735 short tons, worth $171,537, and in 1890, 40,841 short tons, worth $190,416. The production of gilsonite in Utah continues and amounted to 492 short tons in 1889 and 1,105 tons in 1890.

Soapstone.—The use of this material in the form of slabs for various purposes increased. The total product of all kinds was 36,461 short tons in 1889 and 54,024 short tons in 1890. Of this 23,746 short tons and 41,354 short tons, respectively, consisted of fibrous talc from New York.

Mica.—The production decreased in 1889, but is now increasing again; product in 1889, 49,500 pounds, worth $50,000, and in 1890, 60,000 pounds, worth $75,000.

Mineral paints.—The product includes ocher, metallic paints, and some umber and sienna; it amounted to 32,307 long tons in 1889, and 45,732 long tons in 1890.

Graphite.—The principal product in 1889 was 400,000 pounds of refined graphite from Ticonderoga, New York, worth $33,000. In 1890 this product was about stationary. Besides this, cheaper grades were obtained from several localities for use in making foundry facings, etc.

Fluorspar.—The supply from Rosiclare, Illinois, and Evansville, Indiana, is sufficient for the gradually increasing use as a flux in cupola furnaces and for chemical purposes. The product was 9,500 short tons in 1889, and 8,250 short tons in 1890. Some artificial fluorspar is made as a by-product in the decomposition of Greenland cryolite.

Infusorial earth.—From the usual sources the product was 3,466 short tons in 1889, and 2,532 short tons in 1890.

Mineral waters.—Total product in 1889, 12,780,471 gallons, worth $1,748,458, and in 1890, 13,907,418 gallons, with a value of $2,600,750.

Mineral products of the United States for

	Products.	1880.		1881.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, spot value..............long tons..	3,375,912	$89,315,569	4,144,254	$87,029,334
2	Silver, coining value,..........troy ounces..	30,320,000	39,200,000	33,077,000	43,000,000
3	Gold, coining value....................do....	1,741,500	36,000,000	1,676,300	34,700,000
4	Copper, value at New York City...pounds..	60,480,000	11,491,200	71,680,000	12,175,600
5	Lead, value at New York City...short tons..	97,825	9,782,500	117,085	11,240,160
6	Zinc, value at New York City.........do ...	23,239	2,277,432	26,800	2,680,000
7	Quicksilver, value at San Francisco..flasks..	59,926	1,797,780	60,851	1,764,679
8	Nickel, value at Philadelphia......pounds..	329,968	164,984	265,668	292,235
9	Aluminum, value at Pittsburg.........do....	....	....	....	....
10	Antimony, value at San Francisco.short tons.	50	10,000	50	10,000
11	Platinum, value (crude) at San Francisco, troy ounces.	100	400	100	400
	NONMETALLIC (SPOT VALUES).				
12	Bituminous coal..................long tons..	38,242,641	53,443,718	48,179,475	60,224,344
13	Pennsylvania anthracite..............do....	25,580,189	42,196,678	28,500,016	64,125,036
14	Building stone..............................	....	18,356,055	....	20,000,000
15	Petroleum.........................barrels..	26,286,123	24,183,233	27,661,238	25,448,339
16	Lime..................................do....	28,000,000	19,000,000	30,000,000	20,000,000
17	Natural gas.................................	....	....	....	....
18	Cement............................barrels..	2,072,943	1,852,707	2,500,000	2,000,000
19	Salt..................................do....	5,961,060	4,829,566	6,200,000	4,200,000
20	Limestone for iron flux..........long tons..	4,500,000	3,800,000	6,000,000	4,100,000
21	Phosphate rock.......................do....	211,377	1,123,823	266,734	1,980,259
22	Mineral waters................gallons sold..	2,000,000	500,000	3,000,000	700,000
23	Zinc white......................short tons..	10,107	763,738	10,000	700,000
24	Gypsum...............................do....	90,000	400,000	85,000	350,000
25	Borax.............................pounds..	3,692,443	277,233	4,046,000	304,461
26	Mineral paints..................long tons..	3,604	135,840	6,000	100,000
27	Manganese ore........................do....	5,761	86,415	4,895	73,425
28	Asphaltum......................short tons..	444	4,440	2,000	8,000
29	Pyrites.........................long tons..	2,000	5,000	10,000	60,000
30	Crude barytes........................do....	20,000	80,000	20,000	80,000
31	Bromine...........................pounds..	404,690	114,752	300,000	75,000
32	Corundum.......................short tons..	1,044	29,280	500	80,000
33	Marls...........................long tons..	1,000,000	500,000	1,000,000	500,000
34	Precious stones.............................	....	50,000	....	60,000
35	Gold quartz, souvenirs, jewelry, etc..........	....	50,000	....	50,000
36	Flint...........................long tons..	20,000	80,000	25,000	100,000
37	Fluorspar......................short tons..	4,000	16,000	4,000	16,000
38	Graphite..........................pounds..	....	49,800	400,000	30,000
39	Novaculite...........................do....	420,000	8,000	500,000	8,580
40	Feldspar........................long tons..	12,500	60,000	14,000	70,000
41	Chrome iron ore......................do....	2,288	27,808	2,000	30,000
42	Mica..............................pounds..	81,669	127,825	100,000	250,000
43	Slate ground as a pigment.......long tons..	1,000	10,000	1,000	10,000
44	Cobalt oxide......................pounds..	7,251	24,000	8,280	25,000
45	Sulphur........................short tons..	600	21,000	600	21,000
46	Rutile............................pounds..	100	400	200	700
47	Asbestos.............................do....	150	4,312	200	7,000
48	Potters' clay....................longtons..	25,783	200,457	25,000	200,000
49	Grindstones.................................	....	500,000	....	500,000
50	Millstones..................................	....	200,000	....	150,000
51	Ozocerite, refined................pounds..	....	....	....	....
52	Infusorial earth...............short tons..	1,833	45,660	1,000	10,000
53	Soapstone............................do....	8,441	66,665	7,000	75,000
54	Fibrous talc.........................do....	4,210	54,730	5,000	60,000
55	Lithographic stone...................do....	....	....	50	1,000
	Total value of metallic products.............	....	190,039,865	....	192,892,408
	Total value of nonmetallic mineral products.	....	173,279,135	....	206,783,144
	Estimated value of mineral products unspecified.	....	6,000,000	....	6,500,000
	Grand total..............................	....	369,319,000	....	406,175,552

the calendar years 1880 to 1890, inclusive.

1882.		1883.		1884.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,623,323	$106,336,429	4,595,510	$91,910,200	4,097,868	$73,761,624	1
36,197,696	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000	2
1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000	3
91,646,232	16,068,091	117,151,795	18,064,807	145,221,934	17,789,687	4
132,890	12,624,550	143,957	12,322,719	139,897	10,537,042	5
33,765	3,646,620	36,872	3,311,106	38,544	3,422,707	6
52,732	1,487,042	46,725	1,253,632	31,913	936,327	7
281,616	309,777	58,800	52,920	64,550	48,412	8
....	....	83	875	150	1,350	9
60	12,000	60	12,000	60	12,000	10
200	600	200	600	150	450	11
60,861,190	76,076,487	68,531,500	82,237,800	73,730,539	77,417,066	12
31,358,264	70,556,094	34,336,469	77,257,055	33,175,756	66,351,512	13
....	21,000,000	....	20,000,000	....	19,000,000	14
30,510,830	24,065,988	23,449,633	25,790,252	24,218,438	20,595,966	15
31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000	16
....	215,000	....	475,000	....	1,460,000	17
3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000	18
6,412,373	4,320,140	6,192,231	4,211,042	6,514,937	4,197,734	19
3,850,000	2,310,000*	3,814,273	1,907,136	3,401,930	1,700,965	20
332,077	1,992,462	378,380	2,270,280	431,779	2,374,784	21
5,000,000	800,000	7,529,423	1,119,603	10,215,328	1,459,143	22
10,000	700,000	12,000	840,000	13,000	910,000	23
100,000	450,000	90,000	420,000	90,000	390,000	24
4,236,291	338,903	6,500,000	585,000	7,000,000	490,000	25
7,000	105,000	7,000	84,000	7,000	84,000	26
4,532	67,980	6,155	92,325	10,180	122,160	27
3,000	10,500	3,000	10,500	3,000	10,500	28
13,000	72,000	25,000	137,500	35,000	175,000	29
20,000	80,000	27,000	108,000	25,000	100,000	30
250,000	75,000	301,100	72,264	281,100	67,464	31
500	80,000	550	100,000	600	108,000	32
1,080,000	540,000	972,000	486,000	875,000	437,500	33
....	75,000	....	74,050	....	82,975	34
....	75,000	....	133,000	....	140,000	35
25,000	100,000	25,000	100,000	30,000	120,000	36
4,000	20,000	4,000	20,000	4,000	20,000	37
425,000	34,000	575,000	46,000	....	....	38
600,000	10,000	600,000	10,000	800,000	12,000	39
14,000	70,000	14,100	71,112	10,900	55,112	40
2,500	50,000	3,000	60,000	2,000	35,000	41
100,000	250,000	114,000	285,000	147,410	368,525	42
2,000	24,000	2,000	24,000	2,000	20,000	43
11,653	32,046	1,096	2,795	2,000	5,100	44
600	21,000	1,000	27,000	500	12,000	45
500	1,800	550	2,000	600	2,000	46
1,200	36,000	1,000	30,000	1,000	30,000	47
30,000	240,000	32,000	250,000	35,000	270,000	48
....	700,000	....	600,000	....	570,000	49
....	200,000	....	150,000	....	150,000	50
....	....	....	....	....	....	51
1,000	8,000	1,000	5,000	1,000	5,000	52
6,000	90,000	8,000	150,000	10,000	200,000	53
6,000	75,000	6,000	75,000	10,000	110,000	54
....	....	....	....	....	....	55
....	219,755,109	....	203,128,859	....	186,109,599	
....	231,340,150	....	243,812,214	....	221,879,506	
....	6,500,000	....	6,500,000	....	5,000,000	
....	457,595,259	....	453,441,073	....	412,989,105	

Mineral products of the United States for the

	Products.	1885.		1886.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, spot value..............long tons..	4, 044, 525	$64, 712, 400	5, 683, 329	$95, 195, 760
2	Silver, coining value ....troy ounces..	39, 910, 279	51, 600. 000	39, 445, 312	51, 000, 000
8	Gold, coining value ....do....	1, 538, 376	31. 800, 000	1, 881, 250	35. 000, 000
4	Copper, value at New York City...pounds..	170, 962, 607	18, 292, 999	161, 235, 381	16, 527, 651
5	Lead, value at New York City ..short tons..	129, 412	10, 469, 431	135, 629	12, 667. 749
6	Zinc, value at New York City.........do....	40, 688	3, 539, 856	42, 641	3, 752, 408
7	Quicksilver, value at San Francisco .flasks..	32. 073	979, 189	29, 981	1, 060, 000
8	Nickel, value at Philadelphia ......pounds..	277, 904	179, 975	214, 992	127, 157
9	Aluminum, value at Philadelphia, ...do....	283	2, 550	3, 000	27, 000
10	Antimony, value at San Francisco.short ton.	50	10, 000	35	7, 000
11	Platinum, value (crude) at San Francisco, troy ounces.	250	187	50	100
	NONMETALLIC (SPOT VALUES).				
12	Bituminous coal ....long tons..	64, 840, 668	82, 347, 648	65, 810, 676	78. 481, 056
13	Pennsylvania anthracite.............do....	34, 228, 548	76, 671. 948	34, 853, 077	76, 119, 120
14	Building stone	....	19, 000, 000	....	19, 000. 000
15	Petroleum.........................barrels..	21, 847, 205	19. 198. 243	28, 064, 841	19, 996, 313
16	Lime...............................do....	40, 000, 000	20, 000. 000	42, 500, 000	21, 250, 000
17	Natural gas	....	4, 857. 200	....	10, 012, 000
18	Cement ....barrels..	4, 150, 000	3, 492. 500	4, 500, 000	3, 990, 000
19	Salt.................................do....	7, 038, 653	4, 825, 345	7, 707, 081	4, 736, 585
20	Limestone for iron flux ....long tons..	3, 356, 956	1, 678. 478	4, 717, 163	2, 830. 297
21	Phosphate rock......................do....	437, 856	2, 846, 064	430. 549	1, 872. 936
22	Mineral waters, gallons sold................	9, 148. 401	1, 312, 845	8, 950, 317	1, 284, 070
23	Zinc white......................short tons..	15, 000	1, 050, 000	18, 000	1, 440. 000
24	Gypsum ....do....	90, 405	405, 000	95, 250	428. 625
25	Borax..........................pounds..	8, 000, 000	480. 000	9, 778, 290	488, 915
26	Mineral paints ....long tons..	3, 950	43. 575	15. 800	285, 000
27	Manganese ore..................long tons..	23, 258	190. 281	30, 193	277. 636
28	Asphaltum.....................short tons..	3, 000	10, 500	3, 500	14, 000
29	Pyrites ....long tons..	49, 000	220, 500	55, 000	220, 000
30	Crude barytes.......................do....	15, 000	75, 000	10, 000	50, 000
31	Bromine ....pounds..	310, 000	89, 900	428, 334	141. 350
32	Corundum ....short tons..	600	108. 000	645	116. 190
33	Marls................................do....	875, 000	437, 500	800, 000	400, 000
34	Precious stones	....	69, 900	....	79, 056
35	Gold quartz, souvenirs, jewelry, etc	....	140, 000	....	40, 000
36	Flint...........................long tons..	30, 000	120, 000	30. 000	120, 000
37	Fluorspar......................short tons..	5, 000	22, 500	5, 000	22. 000
38	Graphite.......................pounds..	327, 883	26, 231	415. 525	33, 242
39	Novaculite.........................do....	1, 000, 000	15, 000	1, 160, 000	15, 000
40	Feldspar ....long tons..	13, 600	68, 000	14, 900	74. 500
41	Chrome iron ore.....................do....	2, 700	40, 000	2, 000	30, 000
42	Mica............................pounds..	92, 000	161, 000	40, 000	70, 000
43	Slate ground as a pigment ....long tons..	1, 975	24, 687	3, 000	30, 000
44	Cobalt oxide ....pounds..	68, 723	65, 373	35, 000	36. 878
45	Sulphur........................short tons..	715	17, 875	2, 500	75. 000
46	Rutile ....pounds..	600	2, 000	600	2. 000
47	Asbestos...............,......short tons..	300	9, 000	200	6, 000
48	Potters' clay....................long tons..	36, 000	275, 000	40, 000	325. 000
49	Grindstones.............................	....	500, 000	....	250. 000
50	Millstones..............................	....	100, 000	....	140, 000
51	Ozocerite, refined ....pounds..	....	....	....	....
52	Infusorial earth.................short tons..	1, 000	5, 000	1, 200	6. 000
53	Soapstone...........................do....	10, 000	200, 000	12. 000	225, 000
54	Fibrous talc ....do....	10, 000	110, 000	12, 000	125, 000
55	Lithographic stone...................do....	....	....	40	700
	Total value of metallic products........	....	181, 586, 587	....	215, 364, 825
	Total value of nonmetallic mineral products.	....	241, 312, 093	....	245, 139, 469
	Estimated value of mineral products unspecified.	....	5, 000. 000	....	5, 000, 000
	Grand total	....	427, 898, 680	....	465, 504, 294

calendar years 1880 to 1890, inclusive—Continued.

1887.		1888		1889.		1890.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
6,417,148	$121,925,800	6,489,738	$107,000,000	7,603,642	$120,000,000	9,202,703	$151,200,410	1
41,269,240	53,350,000	45,783,632	59,195,000	51,354,851	66,396,988	54,500,000	70,464,645	2
1,596,500	33,000,000	1,604,927	33,175,000	1,590,869	32,886,744	1,588,880	32,845,000	3
185,227,331	21,115,916	231,270,622	33,833,954	231,246,214	26,907,809	265,115,133	30,848,797	4
160,700	14,463,000	180,555	15,924,951	182,967	16,137,689	161,754	14,266,703	5
50,340	4,782,300	55,903	5,500,855	58,860	5,791,824	63,683	6,266,407	6
33,825	1,429,000	83,250	1,413,125	26,484	1,190,500	22,926	1,203,615	7
205,566	133,200	204,328	127,632	252,663	151,598	223,488	134,093	8
18,000	59,000	19,000	65,000	47,468	97,335	61,281	61,281	9
75	15,000	100	20,000	115	28,000	129	40,756	10
448	1,838	500	2,000	500	2,000	600	2,500	11
78,470,857	98,004,656	91,106,998	101,860,529	85,383,059	94,346,809	99,392,871	110,420,801	12
37,578,747	84,552,181	41,624,611	89,020,483	40,714,721	65,879,514	41,489,858	66,383,772	13
....	25,000,000	....	25,500,000	....	42,809,706	....	47,000,000	14
28,278,866	18,877,094	27,612,025	17,947,620	35,163,513	26,963,340	45,822,672	35,365,105	15
46,750,000	23,375,000	49,087,000	24,543,500	68,474,668	33,217,015	60,000,000	35,000,000	16
....	15,817,500	....	22,629,875	....	21,097,099	....	18,742,725	17
6,692,744	5,674,377	6,503,295	5,021,139	7,000,000	5,000,000	8,000,000	6,000,000	18
7,831,962	4,093,846	8,055,881	4,374,203	8,005,565	4,195,412	8,776,991	4,752,286	19
5,377,000	3,226,200	5,438,000	2,719,000	6,318,000	3,159,000	5,521,622	2,760,811	20
480,558	1,836,818	448,567	2,018,552	550,245	2,937,776	510,499	3,213,795	21
8,259,609	1,261,473	9,578,648	1,679,302	12,780,471	1,748,458	13,907,418	2,600,750	22
18,000	1,440,000	20,000	1,600,000	16,970	1,357,600	....	1,600,000	23
95,000	425,000	110,000	550,000	267,769	764,118	182,995	574,523	24
11,000,000	550,000	7,589,000	455,340	8,000,000	500,000	9,500,000	617,500	25
20,000	310,000	24,000	380,000	32,307	463,766	45,732	661,992	26
34,524	333,844	29,198	279,571	24,197	240,559	25,684	219,050	27
4,000	16,000	53,800	331,500	51,735	171,537	40,841	190,416	28
52,000	210,000	54,331	167,658	93,705	202,119	141,836	273,745	29
15,000	75,000	20,000	110,000	19,161	106,313	21,911	86,565	30
199,087	61,717	307,386	95,290	418,891	125,667	387,847	104,719	31
600	108,000	589	91,620	2,245	105,565	1,970	89,395	32
600,000	300,000	300,000	150,000	139,522	63,956	153,620	69,880	33
....	88,600	....	64,850	....	188,807	....	118,833	34
....	75,000	....	75,000					35
32,000	185,000	30,000	175,000	11,113	49,137	13,000	57,400	36
5,000	20,000	6,000	30,000	9,500	45,835	8,250	55,328	37
416,000	34,000	400,000	33,000	....	72,662	....	77,500	38
1,200,000	16,000	1,500,000	18,000	5,982,300	32,980	....	69,909	39
10,200	56,100	8,700	50,000	6,970	39,370	8,000	45,200	40
3,000	40,000	1,500	20,000	2,000	30,000	3,599	53,985	41
70,500	142,250	48,000	70,000	49,500	50,000	60,000	75,000	42
2,000	20,000	2,500	25,000	2,000	20,000	2,000	20,000	43
18,340	18,774	8,491	15,782	13,955	31,092	6,788	16,291	44
3,000	100,000	....	....	1,150	7,850	....	....	45
1,000	3,000	1,000	3,000	1,000	3,000	400	1,000	46
150	4,500	100	3,000	30	1,800	71	4,560	47
43,000	340,000	36,750	300,000	294,344	635,578	350,000	756,000	48
....	224,400	....	281,800	....	439,587	....	450,000	49
....	100,000	....	81,000	....	35,155	....	23,720	50
....	....	43,500	3,000	50,000	2,500	350,000	26,250	51
3,000	15,000	1,500	7,500	3,466	23,372	2,532	50,240	52
12,000	225,000	15,000	250,000	12,715	231,708	13,670	252,309	53
15,000	160,000	20,000	210,000	23,746	244,170	41,354	389,196	54
....	....	....	....	18	243	....	....	55
....	250,275,054	....	256,257,517	....	269,590,487	....	307,334,207	
....	287,416,320	....	303,241,114	....	307,640,175	....	339,270,491	
....	5,000,000	....	5,000,000	....	10,000,000	....	10,000,000	
....	542,691,374	....	564,498,631	....	587,230,662	....	656,604,698	

IRON AND STEEL.

THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES IN 1889, 1890, AND 1891.

COMPARED WITH THE IRON AND STEEL INDUSTRIES OF OTHER COUNTRIES.

By James M. Swank,

General Manager of the American Iron and Steel Association.

Production of pig iron, by States, in 1889 and 1890.—The total production of pig iron in the United States in 1889 was 7,603,642 long tons, and in 1890 it was 9,202,703 long tons. In the following table is given, in short tons, the exact production of pig iron in each of the pig-iron producing States in 1889 and 1890, the States being given in the order of their prominence in 1890.

Production of pig iron, by States, in 1889 and 1890.

States.	1889.	1890.	States.	1889.	1890.
	Short tons.	*Short tons.*		*Short tons.*	*Short tons.*
Pennsylvania	4,181,242	4,945,169	Kentucky	42,518	53,604
Ohio	1,215,572	1,389,170	Georgia	27,559	32,687
Alabama	791,425	914,940	Colorado	2,678	23,588
Illinois	601,035	785.239	Connecticut	24,143	22,552
New York	297,247	369,381	Indiana	9,839	16,398
Virginia	251,356	327,912	Oregon	9,426	12,305
Tennessee	294,655	299,741	Texas	4.544	10,865
Michigan	214,356	258,461	Massachusetts	7,751	5,531
Wisconsin	158,634	246,237	North Carolina	2,898	3,181
New Jersey	125,693	177,788	Maine	5,200	1,200
Maryland	33,847	165,559	Washington	10,371	....
West Virginia	117,900	144,970			
Missouri	86,190	100,550	Total	8,516,079	10,307,028

To show how great was the increase in the production of pig iron in the United States in 1889 and 1890 another table is subjoined, which gives in short tons the total production of pig iron in the United States in the eighty-one years from 1810 to 1890. From 1877 to 1881 we more than doubled our production of pig iron, and from 1885 to 1890 we again more than doubled our production.

Annual production of pig iron for eighty-one years.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1810	60,377	1863	947,604	1877	2,314,585
1820	22,400	1864	1,135,996	1878	2,577,361
1830	184,800	1865	931,582	1879	3,070,875
1840	821,331	1866	1,350,343	1880	4,295,414
1850	632,526	1867	1,461,626	1881	4,641,564
1854	736.218	1868	1,603,000	1882	5,178,122
1855	784,178	1869	1,916,641	1883	5,146,972
1856	883,137	1870	1,865.000	1884	4,589,613
1857	798,157	1871	1,911,608	1885	4,529.869
1858	705,094	1872	2,854.558	1886	6,365.328
1859	840,627	1873	2,868,278	1887	7,187,206
1860	919,770	1874	2,689,413	1888	7,268.507
1861	731,544	1875	2,266,581	1889	8,516,079
1862	787,662	1876	2,093,236	1890	10,307,028

Our production of pig iron compared with that of Great Britain.—To show how rapidly we have in late years overtaken the production of pig iron by Great Britain a table in long tons is appended, giving the production of pig iron by both countries from 1882, when Great Britain reached its maximum, until 1890. The long ton is here used because it is the ton used by Great Britain.

Production of pig iron in the United States and Great Britain.

Years.	Great Britain.	United States.	Years.	Great Britain.	United States.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1882	8,586,680	4,623,323	1887	7,559,518	6,417,148
1883	8,529,300	4,595,510	1888	7,998,969	6,489,738
1884	7,811,727	4,097,868	1889	8,322,824	7,603,642
1885	7,415,469	4,044,526	1890	7,904,214	9,202,703
1886	7,009,754	5,683,329			

Production of pig iron in the Southern States.—Since much attention still continues to be given to the rapid growth of the pig-iron industry in the Southern States a table in short tons is given below, showing the production of pig iron in that section of our country in the six years from 1885 to 1890.

Production of pig iron in the Southern States for six years.

States.	1885.	1886.	1887.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	227,438	283,859	292,762	449,492	791,425	914,940
Tennessee	161,199	199,166	250,344	267,931	294,655	299,741
Virginia	163,782	156,250	175,715	197,396	251,356	327,912
West Virginia	69,007	98,618	82,311	95,259	117,900	144,970
Kentucky	37,553	54,844	41,907	56,790	42,518	53,604
Georgia	32,924	46,490	40,947	39,397	27,559	32,687
Maryland	17,299	30,502	37,427	17,606	33,847	165,559
Texas	1,843	3,250	4,383	6,587	4,544	10,865
North Carolina	1,790	2,200	3,640	2,400	2,898	3,181
Total	712,835	875,179	929,436	1,132,858	1,566,702	1,953,459

Production of spiegeleisen.—The following table shows in short tons the production of spiegeleisen and ferro-manganese in the United States from 1875 to 1890. This production is included in that of pig iron already given.

Production of spiegeleisen and ferro-manganese.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1875	7,832	1881	21,086	1887	47,598
1876	6,616	1882	21,963	1888	54,709
1877	8,845	1883	24,574	1889	85,823
1878	10,674	1884	33,893	1890	149,162
1879	13,931	1885	34,671		
1880	19,603	1886	47,982		

Production of crude steel.—The following table shows the production of all kinds of crude steel in the United States, in the form of ingots or direct castings, in short tons. In the Bessemer column the figures include also the production of steel by the Clapp-Griffiths and Robert-Bessemer modifications of the Bessemer process.

Production of crude steel of all kinds for six years.

Years.	Bessemer.	Open-hearth.	Crucible.	Miscellaneous.	Total.	
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Long tons.*
1885	1,701,762	149,381	64,511	1,696	1,917,350	1,711,920
1886	2,541,493	245,250	80,609	2,651	2,870,003	2,562,503
1887	3,288,357	360,717	84,421	6,265	3,739,760	3,339,071
1888	2,812,500	352,036	78,713	4,124	3,247,373	2,899,440
1889	3,281,829	419,488	84,969	5,734	3,792,020	3,385,732
1890	4,131,535	574,820	79,716	4,248	4,790,319	4,277,071

Production of all kinds of rolled iron, by States, in 1889 and 1890.—The following table gives the production of all kinds of rolled iron, by States, in short tons, in 1889 and 1890, rolled steel not included.

Production of rolled iron, by States, in 1889 and 1890.

States.	1889.	1890.	States.	1889.	1890.
	Short tons.	*Short tons.*		*Short tons.*	*Short tons.*
Maine	10,248	10,588	Tennessee	24,792	22,067
New Hampshire	5,680	3,600	Georgia	1,000	1,500
Massachusetts	39,269	43,540	Ohio	475,120	504,216
Rhode Island	14,140	14,618	Indiana	37,534	67,734
Connecticut	17,451	18,231	Illinois	126,283	146,695
New York	96,279	93,971	Missouri	15,975	22,990
New Jersey	63,209	62,535	Iowa	3,020	....
Pennsylvania	1,355,076	1,479,318	Michigan	21,170	31,149
Delaware	47,584	50,812	Wisconsin	40,055	48,547
			Minnesota	300	2,565
Maryland and District of Columbia	11,164	5,409	Colorado	4,270	8,328
Virginia	51,783	55,224	Wyoming	6,002	10,287
Alabama	50,111	42,691	California	35,061	37,663
West Virginia	6,043	7,046			
Kentucky	27,766	29,053	Total	2,586,385	2,820,377

Production of rolled steel.—In the following table is presented the details of the production of rolled steel, by States, in short tons, in 1889 and 1890, excluding rails, which are given in another table.

Production of rolled steel in 1889 and 1890.

States.	Cut nails.	Plates and sheets.	Other rolled steel.	Total in 1890.	Total in 1889.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
New England States	5,550	5,261	106,618	117,429	97,831
New York New Jersey	134	3,076	86,637	89,847	109.242
Pennsylvania	39,532	288,131	673,919	1,001,582	872,246
Delaware and Maryland	....	2,735	8,835	11,570	2,188
Virginia	2,172	....	....	2,172	2,500
West Virginia and Kentucky	57,555	32,335	8,050	97,940	86,369
Ohio	68,614	66,962	197,832	333,408	295,971
Indiana Illinois	17,395	....	121,905	139,800	87,410
Missouri and Michigan	250	3,037	5,800	9,087	9,580
Wisconsin	38	....	24,138	24,176	13,583
California	500	....	2,236	2,736	7,444
Total	191,740	401,537	1,235,970	1,829,247	1,584,364

Production of steel rails.—The following table shows the production of Bessemer steel rails in 1889 and 1890, by States, in short tons.

Production of steel rails.

States.	1889.	1890.
	Short tons.	*Short tons.*
Pennsylvania	1,141,350	1,470,490
Illinois	522,054	587,537
Other States	27,860	33,951
Total	1,691,264	2,091,978

Production of rolled steel compared with rolled iron.—The following table shows in short tons the total production of rolled steel in 1888, 1889, and 1890 in comparison with the total production of rolled iron in the same years.

Production of rolled steel compared with rolled iron.

Articles.	1888.		1889.		1890.	
	Iron.	Steel.	Iron.	Steel.	Iron.	Steel.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Rails	14,252	1,557,892	10,258	1,694,610	15,548	2,095,996
Cut nails	108,505	216,174	88,904	201,634	90,307	191,740
Plates and sheets	469,312	213,694	471,193	331,283	505,642	401,537
Wire rods	14,571	298,770	14,460	393,053	19,798	492,153
Other rolled products	1,805,014	473,247	2,001,570	658,394	2,189,082	743,817
Total	2,411,654	2,759,777	2,586,385	3,278,974	2,820,377	3,925,243

Production of cut and wire nails.—The following table shows the production by States of iron and steel cut nails, respectively, in 1890, in kegs of 100 pounds, and the total production of that year compared with the total production of 1889, to which is added the total production of wire nails.

Production of cut nails in 1890 and 1889.

States.	1890.			Total 1889.
	Iron.	Steel.	Total.	
	Kegs.	*Kegs.*	*Kegs.*	*Kegs.*
Pennsylvania	1,035,179	790,645	1,825,824	1,834,899
Ohio	46,351	1,372,270	1,418,621	1,546,928
West Virginia	1,252	956,442	957,694	980,346
Indiana	12,865	217,099	229,964	138,200
New Jersey	257,678	2,689	260,367	252,067
Illinois	....	130,806	130,806	204,438
Massachusetts	80,573	111,000	191,573	239,903
California	210,000	10,000	220,000	242,000
Virginia	159,114	43,446	202,560	194,998
Kentucky	....	194,654	194,654	165,000
Wisconsin	3,118	765	3,883	11,435
Missouri	....	5,000	5,000	....
Colorado	....	....	....	544
Total cut nails	1,806,130	3,834,816	5,640,946	5,810,758
Wire nails	....	....	3,135,911	2,435,000
Total nail production			8,776,857	8,245,758

The following table gives the production of wire nails, by States, in 1889 and 1890, in kegs of 100 pounds.

Production of wire nails in 1889 and 1890.

Wire nails—kegs.	New England, New York, and New Jersey.	Pennsylvania.	Ohio.	Other States.	Total.
1889	280, 000	816, 000	944, 000	395, 000	2, 435, 000
1890	335, 595	1, 061, 639	1, 115, 320	623, 357	3, 135, 911

Iron and steel vessels built in the United States.—The following table gives the number and gross tonnage of all iron and steel vessels, except those for the Navy, which have been built in the United States in the fiscal years from 1868 to 1891. Nearly all were steam vessels. Since 1883 we have built many vessels of steel, and the tendency now is to use steel in constantly increasing quantities in the construction of both merchant and naval vessels. This table has been compiled from the reports of the Bureau of Navigation of the Treasury Department.

Years.	No.	Tons.	Years.	No.	Tons.	Years.	No.	Tons.
1868	....	2, 801	1876	25	21, 346	1884	34	35, 631
1869	....	4, 584	1877	7	5, 927	1885	48	44, 028
1870	....	8, 281	1878	32	26, 960	1886	26	14, 908
1871	....	15, 479	1879	24	22, 008	1887	29	34, 354
1872	20	12, 766	1880	31	25, 582	1888	43	36, 719
1873	26	26, 548	1881	42	28, 392	1889	48	53, 513
1874	23	33, 097	1882	43	40, 097	1890	63	80, 378
1875	20	21, 632	1883	35	39, 646	1891	76	105, 618

Summary of production in 1889 and 1890.—In the following table are given the statistics of the production of all leading articles of iron and steel in 1889 and 1890. All products are given in short tons of 2,000 pounds, except nails, which are given in kegs of 100 pounds. (The short ton has been used by the United States Census Office in 1870, 1880, and 1890.)

Production of leading articles of iron and steel in 1889 and 1890.

Products.	1889.	1890.
Pig iron, including spiegeleisen, short tons	8, 516, 079	10, 307, 028
Spiegeleisen, short tons	85, 823	149, 162
Bessemer steel ingots, short tons	3, 281, 829	4, 131, 535
Bessemer steel rails, short tons	1, 691, 264	2, 091, 978
Open-hearth steel ingots, short tons	419, 488	574, 820
Open-hearth steel rails, short tons	3, 346	4, 018
Crucible steel ingots, short tons	84, 969	79, 716
Rolled iron, except rails, short tons	2, 576, 127	2, 804, 829
Rolled steel, except rails, short tons	1, 584, 364	1, 829, 247
Iron rails, short tons	10, 258	15, 548
Pig, scrap, and ore blooms, short tons	36, 260	30, 783
Kegs of iron cut nails, 100 pounds	1, 778, 082	1, 806, 130
Kegs of steel cut nails, 100 pounds	4, 032, 676	3, 834, 816
Kegs of wire nails, 100 pounds	2, 435, 000	3, 135, 911
Iron and steel wire rods, short tons	407, 513	511, 951

Average monthly prices of iron and steel in the United States in 1891.—In the following table we give the average monthly prices of ten leading articles of iron and steel in Eastern markets in 1891. The prices named are per long ton of 2,240 pounds, except for bar iron and nails, which are quoted by the hundred pounds and the keg, respectively. It will be noticed that prices were not only very low all through the year but that they did not greatly vary, the general tendency, however, being steadily downward from January to December. The monthly averages are obtained from weekly quotations.

1891.	Old iron T rails, at Philadelphia.	No. 1 anthracite foundry pig iron, at Philadelphia.	Gray forge pig iron, at Philadelphia.	Gray forge pig iron, Lake ore mixed, at Pittsburg.	Bessemer pig iron, at Pittsburg.	Steel rails, at mills in Pennsylvania.	Best refined bar iron from store, at Philadelphia.	All muck bar iron, at Pittsburg.	Cut nails, at Pittsburg (base price).	Cut nails, at Philadelphia, from store.
January	$23.50	$17.50	$14.50	$14.25	$15.95	$29.00	$2.00	$1.80	$1.65	$1.90
February	23.35	17.50	14.50	14.50	16.25	30.00	1.90	1.75	1.65	1.90
March	22.50	17.50	14.75	15.00	16.50	80.00	1.90	1.75	1.65	1.85
April	22.50	17.50	14.75	14.12	16.10	30.00	1.90	1.70	1.60	1.90
May	22.00	17.50	14.75	14.00	16.50	30.00	1.90	1.70	1.55	1.90
June	21.00	17.50	14.75	14.00	16.25	30.00	1.90	1.70	1.55	1.85
July	21.00	17.50	14.60	14.00	16.25	30 00	1.90	1.70	1.55	1.85
August	21.50	17.50	14.50	14.00	16.00	30.00	1.90	1.70	1.55	1.85
September	22.00	17.50	14.35	14.00	15.60	30.00	1.90	1.70	1.55	1.85
October	22.00	17.75	14.35	13.85	15.50	30.00	1.85	1.70	1.60	1.80
November	21.75	17.50	14.25	13.50	15.15	30.00	1.85	1.68	1.55	1.80
December	21.50	17.50	14.25	13.50	15.35	30.00	1.90	1.68	1.55	1.85

Average yearly prices of iron and steel from 1886 to 1891.—The following table gives the average yearly prices of the articles mentioned in the preceding table from 1886 to 1891, both years inclusive. The prices are per ton of 2,240 pounds, with the exceptions mentioned above. The yearly averages are obtained by averaging the monthly quotations.

Average yearly prices of iron and steel from 1886 to 1891.

Articles.	1886.	1887.	1888.	1889.	1890.	1891.
Old iron T rails, at Philadelphia	$21.42	$22.97	$22.23	$24.19	$25.18	$22.05
No. 1 anthracite foundry pig iron, at Philadelphia	18.71	20.92	18.88	17.75	18.40	17.52
Gray forge pig iron, at Philadelphia	16.40	17.79	16.21	15.48	15.82	14.52
Gray forge pig iron, Lake ore mixed, at Pittsburg	16.58	19.02	15.99	15.37	15.78	14.06
Bessemer pig iron, at Pittsburg	18.96	21.37	17.38	18.00	18.85	15.95
Steel rails, at mills in Pennsylvania	34.50	37.08	29.83	29.25	31.75	29.92
Best refined bar iron from store, at Philadelphia	1.92	2.20	2.01	1.94	2.05	1.90
All muck bar iron, at Pittsburg	1.70	1.95	1.77	1.71	1.85	1.71
Cut nails (base price), at Pittsburg	2.17	2.15	1.90	1.99	1.99	1.58
Cut nails at Philadelphia, from store	2.27	2.30	2.03	2.00	2.00	1.86

Our production of Bessemer steel compared with that of Great Britain.—Since 1879 the United States has annually produced more Bessemer steel rails than Great Britain, and since 1884 it has annually produced more Bessemer steel ingots. In the following table we give the production of Bessemer ingots and rails in each country from 1877 to 1890.

Production of Bessemer steel in the United States and Great Britain.

Years.	United States.		Great Britain.	
	Ingots.	Rails.	Ingots.	Rails.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1877	500,524	385,865	750,000	508,400
1878	653,773	491,427	807,527	622,390
1879	829,439	610,682	834,511	520,231
1880	1,074,262	852,196	1,044,382	732,910
1881	1,374,247	1,187,770	1,441,719	1,023,740
1882	1,514,687	1,284,067	1,673,649	1,235,785
1883	1,477,345	1,148,709	1,553,380	1,097,174
1884	1,375,531	996,983	1,299,676	784,968
1885	1,519,430	959,471	1,304,127	706,583
1886	2,269,190	1,574,703	1,570,520	730,343
1887	2,936,033	2,101,904	2,089,403	1,021,847
1888	2,511,161	1,386,277	2,032,794	979,083
1889	2,930,204	1,510,057	2,140,791	943,048
1890	3,688,871	1,867,837	2,014,843	1,019,606

Reaction in the American iron trade in 1891.—In the month of November, 1890, a serious financial panic occurred in London, growing out of wild speculation in the Argentine Republic and elsewhere. This panic was at once communicated to New York, and it also seriously affected financial operations in Paris, Berlin, and other financial centers. Since its occurrence there has ensued a sharp reaction in the productive activity of all manufacturing countries, their iron and steel industries sharing conspicuously in this reaction. How sharp this reaction has been in the iron and steel industries of the United States may be seen from the following summary of the production of pig iron, Bessemer steel, and Bessemer steel rails in the first six months of 1891, compared with the first six months of 1890.

Comparison of iron and steel activity in 1890 and 1891.

Products.	First six months of—	
	1890.	1891.
	Short tons.	*Short tons.*
Pig iron	5,107,775	3,776,556
Bessemer steel ingots	2,041,239	1,599,096
Bessemer steel rails	1,032,658	579,929

In the months of July and August, 1891, an improved feeling was manifested in all trade circles in the United States, growing out of the large crops in our own country and the short crops in Europe. The domestic iron trade shared conspicuously in this turn in the tide, and during the second half of the year greater activity was noticeable in all lines of production than in the first half. The production of pig iron, which fell off so greatly in the first half of 1891, was actually larger in the second half of the year than in either the first or second half of

1890, as will appear from the following detailed statement. The production in each half of 1890 and 1891 was as follows, in long tons:

Years—long tons.	First half.	Second half.	Total.
1890	4,560,513	4,642,190	9,202,703
1891	3,368,107	4,911,763	8,279,870

Our production of pig iron in the second half of 1891 was 269,573 gross tons larger than in the second half of 1890, which was the half year of largest production in our history prior to 1891. Our production in the second half of 1891 was at the rate of 9,823,526 long tons per annum. It was larger than in any full year in our history down to and including 1885, and larger than Great Britain's production in any whole year down to and including 1867. Although our production of pig iron in the whole of the year 1891 declined as compared with the production in 1890, it was about 1,000,000 long tons larger than that of Great Britain in 1891. The exact figures of Great Britain's production are, however, not yet attainable.

The following table gives in short tons the production of pig iron in each State of the United States during 1891, compared with the production in each of the three preceding years.

Production of pig iron in 1888, 1889, 1890, and 1891.

States.	1888.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Maine	5,574	5,200	1,200	
Massachusetts	13,248	7,751	5,531	10,069
Connecticut	21,644	24,143	22,552	24,428
New York	257,180	297,247	369,381	352,925
New Jersey	101,882	125,693	177,788	103,589
Pennsylvania	3,589,186	4,181,242	4,945,169	4,426,673
Maryland	17,606	33,847	165,559	138,206
Virginia	197,396	251,356	327,912	330,727
North Carolina	2,400	2,898	3,181	3,603
Georgia	39,397	27,559	32,687	55,841
Alabama	449,492	791,425	914,940	891,154
Texas	6,587	4,544	10,865	20,902
West Virginia	95,259	117,900	144,970	96,637
Kentucky	56,790	42,518	53,604	50,225
Tennessee	267,931	294,655	299,741	326,747
Ohio	1,103,818	1,215,572	1,389,170	1,159,215
Indiana	15,260	9,839	16,398	8,657
Illinois	579,307	601,035	785,239	749,506
Michigan	213,251	214,356	258,461	238,722
Wisconsin	116,037	158,634	246,237	220,819
Missouri	91,783	86,190	100,550	32,736
Minnesota				1,373
Colorado	20,877	2,678	23,588	20,290
Oregon	2,509	9,426	12,305	10,411
Washington	4,093	10,371		
Total	7,268,507	8,516,079	10,307,028	9,273,455

The shrinkage in production in 1891 as compared with 1890 was shared by most of the pig-iron-producing States in the North and West, most notably by Pennsylvania, which lost over half a million short tons, all in the first half of the year. But the Southern States lost in the aggregate less than 40,000 short tons, while many of them actually increased their production in 1891 over 1890, as will be seen from the following table.

States—net tons.	First half 1891.	Second half 1891.	Total 1891.	Total 1890.
Alabama	376,389	514,765	891,154	914,940
Tennessee	145,066	181,681	326,747	299,741
Virginia	141,908	188,819	330,727	327,912
West Virginia	20,977	75,660	96,637	144,970
Kentucky	18,779	31,446	50,225	53,604
Georgia	20,401	35,440	55,841	32,687
Maryland	49,992	88,214	138,206	165,559
Texas	8,465	12,437	20,902	10,865
North Caroliua	1,003	2,600	3,603	3,181
Total	782,980	1,131,062	1,914,042	1,953,459

THREE GREAT IRON AND STEEL MAKING COUNTRIES.

The United States, Great Britain, and Germany are the three leading iron and steel making countries, as they long have been, but not in the order named. There was a time when Germany was first and Great Britain was second. For about 100 hundred years Great Britain has been first. For a number of years, however, as has been shown, the United States has been the leading producer of Bessemer steel, and in 1890, as has also been shown, it was the leading producer of pig iron. The reader will be interested in the authentic statistics of the production of pig iron by Great Britain and Germany for a long series of years, which will now be given.

Great Britain.—The following table shows the growth of the pig-iron industry of Great Britain from 1788 to 1890. For this valuable and accurate table we are indebted to the courtesy of Mr. Richard Meade, of the Mineral Statistics Branch of the Home Department of Her Majesty's Government. The table is compiled from the records of the department. It begins with the revival of the British iron industry which followed the general introduction of the use of coke in the blast furnace in the latter half of the last century.

Production of pig iron in Great Britain since 1788.

Years.	Long tons.	Years.	Long tons.	Years.	Long tons.
1788	68,300	1852	2,701,000	1872	6,741,929
1796	125,079	1854	3,069,838	1873	6,566,451
1806	243,851	1855	3,218,154	1874	5,991,408
1818	325,000	1856	3,586,377	1875	6,365,462
1820	400,000	1857	3,659,447	1876	6,555,997
1823	455,166	1858	3,456,064	1877	6,608,664
1825	581,367	1859	3,712,904	1878	6,381,051
1827	690,000	1860	3,826,752	1879	5,995,337
1828	703,184	1861	3,712,390	1880	7,749,233
1830	677,417	1862	3,943,469	1881	8,144,449
1833	700,000	1863	4,510,040	1882	8,586,680
1836	1,000,000	1864	4,767,951	1883	8,529,300
1839	1,248,781	1865	4,825,254	1884	7,811,727
1840	1,396,400	1866	4,523,897	1885	7,415,469
1842	1,099,138	1867	4,761,023	1886	7,009,754
1843	1,215,350	1868	4,970,206	1887	7,559,518
1844	1,999,608	1869	5,445,757	1888	7,998,969
1845	1,512,500	1870	5,963,515	1889	8,322,824
1847	1,909,508	1871	6,627,179	1890	7,904,214

Exactly one hundred and fifty-one years ago, in 1740, the production of pig iron in Great Britain was only 17,350 tons, the denudation of her forests, from which a supply of charcoal fuel had been obtained, having almost destroyed her pig-iron industry.

Great Britain has been a large importer in recent years of iron ore from Spain, Italy, and other countries, but chiefly from Spain. In 1887 the quantity imported amounted to 3,765,788 tons, in 1888 to 3,562,071 tons, in 1889 to 4,031,265 tons, and in 1890 to 4,471,790 tons. Great Britain also annually imports large quantities of cupreous iron pyrites, from which she obtains "purple ore" as a residuum for use in her blast furnaces. She obtained 447,580 tons of "purple ore" from this source in 1887, 464,207 tons in 1888, 483,257 tons in 1889, and 492,669 tons in 1890. The total quantity of iron ore mined in Great Britain in 1887 amounted to 13,098,041 tons, in 1888 to 14,590,713 tons, in 1889 to 14,546,105 tons, and in 1890 to 13,780,767 tons. Great Britain, therefore, now imports nearly one-fourth of her annual supply of iron ore. The sources of her supply of foreign ore in 1889 and 1890 and the quantities and values of the imports in these years were as follows:

Sources of the foreign iron-ore supply of Great Britain.

Countries from which imported.	1889.		1890.	
	Long tons.	Values.	Long tons.	Values.
Australasia	1,858	£8,026	3,475	£15,266
Greece	79,007	79,314	112,764	101,662
Algeria	205,670	153,836	237,609	190,940
Italy	79,312	68,542	46,517	48,411
Spain	3,627,646	2,608,856	4,028,672	3,129,656
Turkey	19,588	88,131	18,968	90,036
Other countries	18,184	17,900	23,785	25,085
Total	4,031,265	£3,024,605	4,471,790	£3,596,056

Great Britain's exports of iron ore are usually only nominal, but in 1886 and 1887 they attained respectable proportions. In 1886 they amounted to 70,527 tons, of which 69,639 tons were sent to the United States. In 1887 they amounted to 56,394 tons, of which 53,817 tons were sent to the United States. In 1888 the total exports amounted to 9,730 tons, in 1889 to 5,371 tons, and in 1890 to 7,567 tons.

As the prosperity of the British iron trade rests so completely upon the abundant supply of bituminous coal, which is found in many parts of England, Scotland, and Wales, the statistics of its production will properly find a place in these pages. The following table shows the annual production of coal in Great Britain from 1855 to 1890. This table has been carefully revised for this report by Mr. Meade.

Annual production of coal in Great Britain.

Years.	Long tons.	Years.	Long tons.	Years.	Long tons.
1855	64, 453, 079	1867	104, 500, 480	1879	133, 720, 393
1856	66, 645, 450	1868	103, 141, 157	1880	146, 969, 409
1857	65, 394, 707	1869	107, 427, 557	1881	154, 184, 300
1858	65, 008, 649	1870	110, 431, 192	1882	156, 499, 977
1859	71, 979, 765	1871	117, 352, 028	1883	163, 737, 327
1860	80, 042, 698	1872	123, 497, 316	1884	160, 757, 779
1861	84, 013, 941	1873	128, 680, 131	1885	159, 351, 418
1862	81, 638, 338	1874	126, 590, 108	1886	157, 518, 482
1863	86, 292, 215	1875	133, 306, 485	1887	162, 119, 812
1864	92, 787, 873	1876	134, 125, 166	1888	169, 935, 219
1865	98, 150, 587	1877	134, 179, 968	1889	176, 916, 724
1866	101, 630, 544	1878	132, 612, 063	1890	181, 614, 288

A steady decline in the production of coal in Great Britain from 1883 to 1886 will be noticed; but in 1887 the production increased, in 1888 and in 1889 it still further increased, and in 1890 the quantity of coal mined reached the astonishing total of 181,614,288 tons.

Germany.—The growth of the iron and steel industries of Germany in recent years has been very rapid. The following table, which has been carefully revised for these pages by Dr. Hermann Wedding, of Berlin, shows the production of pig iron in Germany and the Grand Duchy of Luxemburg, included in the Zollverein, from 1844 to 1890.

Pig iron production of Germany from 1844 to 1890.

Years.	Metric tons.	Years.	Metric tons.	Years.	Metric tons.
1844	171, 000	1869	1, 413, 029	1880	2, 729, 038
1854	369, 000	1870	1, 391, 124	1881	2, 914, 009
1860	529, 087	1871	1, 563, 682	1882	3, 380, 806
1861	591, 593	1872	1, 988, 394	1883	3, 469, 719
1862	696, 350	1873	2, 240, 575	1884	3, 600, 612
1863	812, 555	1874	1, 906, 263	1885	3, 687, 433
1864	904, 658	1875	2, 029, 389	1886	3, 528, 658
1865	988, 191	1876	1, 846, 345	1887	4, 023, 953
1866	1, 046, 954	1877	1, 934, 726	1888	4, 337, 421
1867	1, 113, 606	1878	2, 147, 641	1889	4, 524, 558
1868	1, 264, 347	1879	2, 226, 587	1890	4, 658, 451

In 1834, ten years earlier than the year first named in the table, the production of pig iron in Germany and Luxemburg was only 110,000 metric tons.

Germany and Luxemburg produced 10,664,307 tons of iron ore in 1888, 11,002,187 tons in 1889, and 11,406,132 tons in 1890. Of the iron ore produced in these commercially united countries more than one-half is now supplied by the "minette" of Lothringen and Luxemburg. The imports of iron ore into Germany and Luxemburg, chiefly from Spain, amounted to 1,163,373 tons in 1888, 1,234,789 tons in 1889, and 1,522,181 tons in 1890; and the exports, chiefly from Lothringen, amounted to 2,211,820 tons in 1888, 2,179,836 tons in 1889, and 2,208,120 tons in 1890. The exports are mainly to France and Belgium.

As the iron and steel industries of Germany owe their present prominence in large part to the possession by Germany of an abundant local supply of mineral fuel, a table is given below, also verified for these pages by Dr. Wedding, showing the aggregate production of both coal and lignite in Germany from 1853 to 1890.

Production of coal and lignite in Germany from 1853 to 1890.

Years.	Metric tons.	Years.	Metric tons.	Years.	Metric tons.
1853	10,714,556	1869	34,343,913	1880	59,118,035
1857	14,867,121	1870	34,003,004	1881	61,540,485
1860	16,730,492	1871	37,856,110	1882	65,378,211
1861	18,755,361	1872	42,324,467	1883	70,442,648
1862	20,660,677	1873	46,145,194	1884	72,113,820
1863	22,366,203	1874	46,658,145	1885	73,675,515
1864	25,612,899	1875	47,804,054	1886	73,682,584
1865	28,552,762	1876	49,550,461	1887	76,232,618
1866	28,162,805	1877	48,229,882	1868	81,960,083
1867	30,802,889	1878	50,519,899	1889	84,973,230
1868	32,879,123	1879	53,470,716	1890	89,290,834

In 1848 the total production of coal and lignite in Germany was only 5,800,985 metric tons.

Results accomplished by the United States in the production of pig iron, steel, iron ore, and coal.—The position of the United States among iron and steel producing countries at the present time is correctly indicated in the following table of the world's production of pig iron and steel of all kinds, which has been compiled by the writer from the latest and most reliable statistics that are accessible. Most of the details are derived from official sources, while only those relating to "other countries" have been estimated. This table places the world's production of pig iron in 1890 at 26,937,113 tons and the world's production of steel in that year at 12,255,899 tons. The percentage of pig iron produced by the United States was 34.2 and its percentage of steel was 34.9. Tons of 2,240 pounds are used in giving the statistics of Great Britain, the United States, Canada, and "other countries," and metric tons of 2,204 pounds for all the continental countries of Europe. As the difference between the long ton and the metric ton is so trifling it is not necessary, as has been explained in previous references to foreign statistics, to change official figures.

World's production of pig iron and steel.

Countries.	Pig iron.		Steel.	
	Years.	Tons.	Years.	Tons.
United States	1890	9,202,703	1890	4,277,071
Great Britain	1890	7,904,214	1890	3,679,043
Germany and Luxemburg	1890	4,658,451	1890	2,232,099
France	1890	1,970,160	1890	704,013
Belgium	1890	781,958	1890	239,266
Austria and Hungary	1890	925,308	1890	440,605
Russia (including Siberia)	1889	745,872	1889	263,719
Sweden	1890	456,102	1890	169,286
Spain	1890	179,433	1890	63,011
Italy	1889	13,473	1889	157,899
Canada	1890	19,439	1889	24,887
Other countries	1890	80,000	1890	5,000
Total	....	26,937,113	....	12,255,899
Percentage of the United States	....	34.2	....	34.9

In the following table we also give the latest accessible information concerning the production of coal and iron ore throughout the world. The percentage of production of coal by the United States is seen by this table to have been 27.9, and its percentage of production of iron ore is seen to have been 28.3.

The world's production of iron ore and coal.

Countries.	Iron ore.		Coal.	
	Years.	Tons.	Years.	Tons.
United States	1890	16,036,043	1890	140,882,729
Great Britain	1890	13,780,767	1890	181,614,288
Germany and Luxemburg	1890	11,406,132	1890	89,290,834
France	1887	2,579,465	1890	25,836,953
Belgium	1889	202,431	1890	20,343,495
Austria and Hungary	1890	2,200,000	1889	25,326,417
Russia (including Siberia)	1888	1,433,513	1889	6,228,000
Sweden	1890	941,241	1890	258,000
Spain	1890	5,788,742	1891	1,314,147
Italy	1889	173,489	1889	390,320
Canada	1890	68,313	1890	2,783,626
Other countries (including Cuba)	1890	2,000,000	1890	11,200,000
Total	....	56,610,137	....	505,468,809
Percentage of the United States	....	28.3	....	27.9

It is not pretended that all of the details in the above tables are absolutely accurate; at the present stage of statistical inquiry even in highly civilized countries this would be impossible. But they are substantially accurate.

To recapitulate: It is found by the foregoing tables that the United States now produces over 34 per cent. of the world's production of pig iron, over 35 per cent. of its production of steel, 28.3 per cent. of its production of iron ore, and nearly 28 per cent. of its production of coal. These are wonderful and even amazing results. Such industrial progress in a brief time as is here illustrated the world has never before known.

IRON ORES.

BY JOHN BIRKINBINE.

As the basis of iron manufacture is the natural raw material entering into the production of the metal, a consideration of the advances made in the exploitation of domestic iron ore mines and the quantities of the various kinds of iron ores produced and consumed in the United States appear to be proper starting points for statistical discussion of the iron and steel industries, and for this purpose the following information concerning the amount and character of iron ores mined in the various States, also the quantities of foreign iron ores imported, and of other materials used as iron ores in the United States, is presented:

The estimated quantity of iron ore produced in 1890 (16,036,043 long tons) and the foreign iron ore imported (1,246,830 long tons) does not represent all of the material used as iron ores. Many of the blast furnaces employ as part of the charge cinder from puddling and heating furnaces, which contains about 60 per cent. of iron, and a few "blue-billy," the residuum from burning pyrites in the production of sulphuric acid. A residuum cinder, containing iron and manganese, resulting from the treatment of the New Jersey franklinite, is also utilized in several blast furnaces to produce spiegeleisen. The quantities of such material used in 1890 is estimated at 850,000 long tons.

In several of the States the number of small operators prevent obtaining absolutely correct returns, but adding, say, 1½ per cent. of the total output to cover these, to the importations of foreign ore and the quantities of other materials employed as iron ores, there was an apparent available supply in 1890 of 18,400,000 long tons.

The principal uses to which iron ores are put, are—

(1) The production of pig iron by smelting the ores in blast furnaces, and the production of wrought iron direct from the ore in forges or by other direct processes.

(2) Fix or fettling, lining for heating and puddling furnaces.

(3) Flux in smelting furnaces producing precious metals.

(4) The manufacture of paint. (The figures for this were not collected.)

In this report the iron ores are classed under the following heads:

Red hematite.—Those ores in which the iron is found as an anhydrous sesquioxide, including "specular," "fossil," "micaceous," "martite," "slate iron ores," etc. They range in color from light red to steel gray, and are recognized by a red streak on a test plate.

Brown hematite.—Includes all those ores in which the iron is found as a hydrated sesquioxide, the color ranging from yellow to dark brown and black. This class includes "bog ore," "limonite," "turgite," "goethite," etc., and is recognized by a brown streak on a test plate.

Magnetite.—Includes all those ores in which the iron occurs principally as magnetic oxide of iron, viz, Fe_3O_4. These ores are magnetic and give a black streak.

Carbonate.—Comprises ores in which the protoxide of iron is associated with a large percentage of carbonic acid, and includes "black band," "spathic," "siderite," and "clay iron stones." They are generally light gray to brown, sometimes dark brownish red, according to the extent to which they are weathered.

Local names, or those indicating peculiarities of structure, are used to designate some special ores in the above classes. Thus, in the red hematite division there are "flaxseed" ore, "blue hematite," "hard fossil," "soft fossil," etc. In the brown hematites, "pipe ore," "grape ore," and in carbonates, "kidney ore," "limestone ore," etc.

The division above adopted will correspond with the general method used in selling and purchasing iron ores in the United States.

The following table exhibits by States (except where but one or two firms or individuals were producers in a State) the quantities of each kind and the totals of all kinds of iron ore mined, as reported, together with the proportion of the total production of iron ore in the United States, which is represented by the output of each subdivision in the calendar year 1890.

Productions of various kinds of iron ore in 1890 by States.

States.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total of all kinds of iron ore.	Percentage.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	
Michigan	6,426,077	402,274	313,305		7,141,656	44.54
Alabama	1,538,297	359,518			1,897,815	11.83
Pennsylvania	143,745	415,779	765,318	36,780	1,361,622	8.50
New York	196,035	30,968	945,071	81,319	1,253,393	7.82
Wisconsin	784,257	164,708			948,965	5.92
Minnesota	861,910				891,910	5.56
Virginia	16,212	522,908	4,463		543,583	3.39
New Jersey	6,000		489,808		495,808	3.09
Tennessee	278,076	187,619			465,695	2.90
Georgia	69,271	174,817			244,088	1.52
Missouri	159,440	22,250			181,690	1.13
Ohio				169,088	169,088	1.05
Colorado	14,698	99,577			114,275	.71
Montana	3,632	48,000	30,000		81,632	.51
Oregon						
New Mexico						
Utah						
Kentucky		15,685		62,000	77,685	.48
Maryland		23,343		12,314	35,657	.22
Massachusetts		32,934			32,934	.21
Connecticut		26,058			26,058	.16
West Virginia		9,000		16,116	25,116	.16
North Carolina			22,873		22,873	.14
Texas		22,000			22,000	.14
Maine		2,500			2,500	.02
Total	10,527,650	2,559,938	2,570,838	377,617	16,036,043	100.00
Percentage of total	65.65	15.96	16.03	2.36	100.00	

The above table shows that the estimated output of the iron-ore mines of the United States in 1890 was 16,036,043 long tons, an increase over the 1889 output (viz, 14,518,041 long tons) of 1,518,002 long tons, or 10.46 per cent. Most of this increase was in the red hematite mines, their total production for 1890 being 10,527,650 long tons against 9,056,288 tons in 1889, a gain of 1,471,362 long tons, or 16.25 per cent. The magnetite ores also show an increase of 64,423 long tons, or 2.57 per cent. over the output of 1889, the 1890 product being 2,570,838 long tons, while that of the year previous was 2,506,415 long tons. The brown hematite output in 1890 was 2,559,938 long tons and 2,523,087 tons were produced in 1889, the gain over 1889 being 36,851 long tons, or 1.46 per cent. The carbonate mines, on the other hand, show a decrease from 432,251 tons, the 1889 output, to 377,617 tons in 1890, a difference of 54,634 tons, or 12.64 per cent.

In the table the States are arranged in the order of their prominence as iron-ore producers, according to the tonnage of ore won, independently of its quality, and in the data following the larger producing States have been taken up in the same order. If the ore products of each State are compared in accordance with their pig-iron producing values, *i. e.*, with the relation to the contents of metallic iron, the amounts credited to the various States will be somewhat changed, and in several instances the relative rank will be affected.

In 1890 only twenty-three States and two Territories contributed to the output of the United States as against twenty-six States and two Territories in 1889. In the State of Washington the furnace which was in blast in 1889 was idle in the year following, and the new plants projected not having been completed the iron-ore mines of that State were not operated in 1890.

The mines in Idaho and Delaware were also reported inactive in 1890.

The neglect or refusal of some producers to supply the information asked for does not affect the totals materially, as in most cases it has been possible to approximate closely the amounts of iron ore mined when official figures were not obtained. The quantities mined and the distribution of the iron-ore output given below, while not absolutely exact, are, therefore, very close to the actual amounts.

No attempt has been made to subdivide the production further than by States, as this would complicate the data and necessitate separating the reported outputs of some mining companies. In several instances two or more States have been grouped so as not to make public the business of the only individuals or corporations operating in one of them, unless specific consent to such publication had been given.

The following memoranda concerning the iron ores of the various States are presented to supplement the data given in the table. In addition, other information as to the distribution of the different kinds of ore in the various States is also given.

PRODUCTION OF IRON ORE IN VARIOUS STATES IN 1890.

Michigan had the largest product, 7,141,656 long tons, or 44.54 per cent. of that of the entire country in 1890, and this State reported 77 producing mining operations, indicating an average annual output per property of 92,749 long tons. Of the total for the State, however, 88.25 per cent., or 6,302,729 long tons, were obtained from 32 mining operations, each contributing 50,000 long tons or over. These 32 mining operations represented 39 mines, some of which consisted of a number of openings, and if these are segregated, leaving out those under 50,000 tons, it will be found that in Michigan 35 mines together produced 6,225,900 long tons, an annual average of 177,883 tons per mine. Of the iron ores obtained from Michigan 89.98 per cent. was red hematite, 5.63 per cent. was brown hematite, and 4.39 per cent. was magnetite. Michigan contributed 61.04 per cent. of all the red hematite, 15.71 per cent. of all the brown hematite, and 12.19 per cent. of all the magnetite mined in the United States in 1890. The State therefore ranks first among the red hematite, third among the brown hematite, and fourth among the magnetite producers. All of the producing mines are embraced in the Lake Superior region, of which they form an important part. The whole of the Marquette range, most of the mines in the Menominee range, and the largest producers in the Gogebic range are in the State of Michigan. All of the blast furnances of Michigan use charcoal as fuel, and the plants are therefore of comparatively small size. Basing the ore supply for these furnaces on the pig-iron output of 1890, the blast furnaces of Michigan would consume about 400,000 tons, which is but 5.60 per cent. of the total iron ore which the State produced; hence the ore must seek other markets, principally in New York, Pennsylvania, Ohio, and West Virginia. Chicago, Illinois, and Milwaukee, Wisconsin, are also large consuming points.

Although some ore had been taken out previously, the beginning of shipments from the Michigan mines may be said to have been in 1854, since which time there has been an almost constant growth, an output of 1,000,000 long tons per annum being first reached in 1873, 2,000,000 tons were supplied in 1881, 3,000,000 tons in 1886, 4,000,000 tons in 1888, 5,000,000 tons in 1889, and 7,000,000 long tons in 1890. The mines of Michigan were wrought until 1865 before an aggregate of 1,000,000 tons had been won, the outputs of the three succeeding years added more than another million tons, while the year following augmented the aggregate of iron ore won to over 3,000,000 tons in 1869. For the following ten years the annual output grew from one-half million to one and a quarter million tons, and up to 1878 the aggregate production of the Michigan mines reached a total of 11,892,273 long tons. By the close of the year 1880 the output had amounted to a total of 15,261,352 long tons. But in the last decade a total of nearly 36,000,000 tons has been added to the Michigan iron-ore production. In the year 1890 as much iron ore was won from the Michigan mines as from the earliest exploration to and including the year 1873, and in the past four years as much iron ore has been mined as in the thirty preceding years.

In the table which follows the Michigan output of iron ore has been inserted, and also the prevailing freight rates for each year for ore shipped from Marquette or Escanaba to ports on the lower lakes, as reported by the State commissioner of mineral statistics. Other ports have been added since 1885, and the prevailing rates from these can be compared with those of the older shipping ports of Marquette and Escanaba, from which the bulk of Michigan iron ores was furnished:

Total iron ore shipments and lake freights from Michigan mines to date.

Years.	Iron ore shipments from Michigan.	Freight rate by lake vessel per long ton.		Years.	Iron ore shipments from Michigan.	Freight rate by lake vessel per long ton.	
		From Marquette.	From Escanaba.			From Marquette.	From Escanaba.
	Long tons.				*Long tons.*		
Previous to 1854.	75,083	....	....	1872	948,553	$2.85 to 6.60	$2.00 to 5.25
1854	3,000	....	....	1873	1,195,234	3.25 4.00	2.30 3.00
1855	1,449	....	....	1874	899,934	1.60 2.50	1.30 1.40
1856	6,790	$3.00	....	1875	881,166	1.30 1.50	1.10 1.30
1857	25,646	3.00	....	1876	993,311	1.25 2.20	.70 1.40
1858	22,876	$2.00 to 2.50	....	1877	1,025,129	1.25 2.00	.65 1.50
1859	68,832	2.00 2.50	....	1878	1,127,583	1.00 1.50	.60 1.15
1860	114,410	2.00 2.50	....	1879	1,420,745	1.25 3.00	.70 2.10
1861	49,909	2.00 3.00	....	1880	1,948,334	2.00 2.75	1.50 2.00
1862	124,169	2.25 4.50	....	1881	2,125,729	2.00 2.30	1.00 1.60
1863	203,055	3.00 4.00	....	1882	2,656,933	1.25 2.00	.90 1.40
1864	247,059	3.00 5.00	....	1883	2,518,048	1.30 1.75	.90 1.50
1865	193,758	2.05 5.00	....	1884	2,225,146	1.00	.65
1866	296,713	2.75 6.50	$2.50 to 5.75	1885	2,205,190	1.40	1.00
1867	565,504	2.00 4.00	1.05 3.05	1886	3,179,511	1.75	1.35
1868	510,522	2.25 3.25	1.06 2.06	1887	3,934,339	2.15	1.75
1869	639,097	2.75 4.50	1.05 2.05	1888	4,113,803	1.10 1.15	.90 1.45
1870	859,507	2.05 3,25	1.65 2.50	1889 (*a*).	5,856,169	.90 1.25	.90 1.25
1871	813,984	2.05 4.00	1.50 2.50	1890 (*b*).	7,141,656	1.25 1.10	1.10 1.00

a Census report (production). *b* U. S. Geological Survey (production).

Attention is called to the fact that the freight rates given in the preceding table and in two which follow are merely the charges for vessel carriage from the shipping docks on lakes Superior and Michigan to the receiving docks on Lake Erie. The figures given do not include the necessary railroad tolls from the mines to the shipping docks, the distance varying from 12 miles, the shortest in the Marquette range, to nearly 100 miles in the Vermilion range; in fact, some of the Gogebic ore loaded at Escanaba travels even a greater distance. Neither do the vessel freight rates include the dock charges. The figures of freight rates have been inserted as a matter of record and to illustrate the varying conditions which affect shipments in the Lake Superior region. While the rates show considerable fluctuation due to market conditions, the general tendency has been a decline in prices owing to the improved transportation facilities offered by larger and speedier vessels. Some of the important producers own or control a fleet of vessels for handling the products of their mines.

Alabama has risen to second place as a producer of iron ore, and is credited with 1,897,815 long tons, or 11.83 per cent. of the total output for the United States for 1890. This State was given second rank in the Eleventh Census, but the absence of some specific information made its claim to this position uncertain. In 1890, however, the increased activity of the mines of this State places it unmistakably second to Michigan. Alabama's ore product was confined to red and brown hematite, 81.06 per cent. of the total being red hematite and 18.94 per cent. brown hematite. The State ranks second among the red hematite and fourth among the brown hematite producers, having contributed 14.61 per cent. of the total red hematite and 14.04 per cent. of the total brown hematite mined in the United States in 1890.

The geological formation, which has made the ore beds of Alabama unusually extensive and easily worked, has encouraged the erection of numerous large blast furnaces, requiring an output of iron ore for the State ten times larger than it was a decade ago. Alabama is practically a consumer of all the iron ore which it produces; for although some ore is sent from the State into Tennessee and some brought in from Georgia, Alabama is practically independent of other States in regard to its present iron ore supply. While the number and extent of the iron ore deposits in Alabama are remarkable, the rapid increase in blast furnace capacity, will, when all are in operation, have a tendency to deplete the ores which can now be cheaply obtained, and threaten a possible scarcity of cheap native ores for some of the furnaces now built.

Pennsylvania ranks third as a producer, and contributed each of the four kinds of iron ore. New York is the only other State which supplied more than three varieties as above classified.

The production of iron ore in Pennsylvania in 1890 was 1,361,622 long tons, which represents 8.50 per cent. of the total of the United States. The maximum output of any mine reporting was 686,302 long tons, from the Cornwall Ore Hills. No other mine in the State approached this amount; therefore, while Pennsylvania ranks first in the number of mines, these are as a rule small producers when compared with the mines of other States.

The output of Pennsylvania was divided among the different classes of ore in the following proportions: Magnetite, 56.21 per cent.; brown hematite, 30.53 per cent.; red hematite, 10.56 per cent.; carbonate, 2.70 per cent.

The State, on account of the large output of the Cornwall Ore Hills, ranks second as a producer of magnetite, and contributed 29.77 per cent. of the total magnetite mined in the United States in 1890. It also occupied second place in brown hematite production, having contributed from numerous mines 415,779 long tons, or 16.24 per cent. of the total of this class of ore. Its output of red hematite being 1.37 per cent. of the total for the United States, gives Pennsylvania eighth place in this class, while its smaller production of carbonate ore represented 9.74 per cent. of the total, and places it fourth in that class. Notwithstanding the high rank held by Pennsylvania, it produced but one-sixth of the iron ore which was consumed in that State in 1890. The growth of the Bessemer steel industry requiring large amounts of pig iron low in phosphorus, the low cost of Lake Superior and foreign ores, carrying high percentages of iron, due to improved transportation facilities, consolidation of mines, etc., and the consequent lower fuel consumption per ton of iron possible, have led blast furnace managers to draw largely on these sources of supply, displacing the leaner or impure native ores. Some of the scattered workings have also been abandoned from various causes, and hence there has been a decline from former years in the iron ore output of the State.

The output of the Cornwall Ore Hills has been collected from records by Mr. J. Taylor Boyd, superintendent. It is shown in the following table and indicates that of the total output to date practically one-half was mined in the last ten years, the aggregate for 1881 to 1890, both inclusive, being 5,376,562 long tons; that is, in ten years nearly as much ore has been taken from the Cornwall Ore Hills as in the previous one hundred and forty years.

Production of iron ore at the Cornwall Ore Hills, Cornwall, Pennsylvania.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
From 1740 to February, 1864	2,518,910	1878	179,299
1864 (11 months)	165,915	1879	268,488
1865	114,803	1880	231,173
1866	216,660	1881	249,050
1867	202,755	1882	309,681
1868	165,843	1883	363,144
1869	173,429	1884	412,320
1870	174,408	1885	508,864
1871	176,055	1886	688,054
1872	193,317	1887	667,210
1873	166,782	1888	722,917
1874	112,429	1889	769,020
1875	96,925	1890	686,302
1876	137,902		
1877	171,589	Total	10,845,244

New York follows Pennsylvania with a total output of 1,253,393 long tons, or 7.82 per cent. of the total iron ore product for the United States. Of this amount 945,071 long tons, or 75.40 per cent., was magnetite, 196,035 long tons, or 15.64 per cent., was red hematite, 81,319 long tons, or 6.49 per cent., was carbonate, and 30,968 long tons, or 2.47 per cent., was brown hematite. This State headed the list of magnetite producers with 36.76 per cent. of the total for the United States. It occupied second position as to carbonates, with 21.53 per cent. of the total; ranked sixth as to red hematites, with 1.86 per cent. of the total for this class of ore, and also contributed 1.21 per cent. of the brown hematites, taking eleventh position in that class.

The magnetites of New York and some of the carbonates and red and brown hematites are liberally drawn upon to supplement the local supplies of Pennsylvania furnaces, as the former State produced more iron ore than it used. On the other hand, the ores from the Lake Superior region find convenient access to the State from the Great Lakes, which are its northern and western boundaries; in addition some foreign ores are used in the blast furnaces to supplement local ores. A considerable increase in the output of magnetite iron ore is anticipated in the future, due to the operation of concentrating plants which have been or are being constructed. These are referred to under the head of concentration.

In "Mineral Resources of the United States, 1886," the output prior to that date from the mines in the Lake Champlain district appears, and the following table will bring these quantities up to date:

Total production of iron ore in the Lake Champlain district, New York.

Years.	Production.
	Long tons.
Output prior to 1886	(*a*)13, 000, 000
1886	588, 829
1887	768, 852
1888	669, 553
1889	779, 900
1890	821, 994
Total	16, 629, 128

a. Estimated.

The extensive contract of removing the roof of the Tilly Foster magnetite mine in Putnam county, New York, has been completed, and ore is now taken from a great open cut 350 feet deep. Much of that removed having been left in pillars, or in the roof and floors of the older underground exploitations. At the Croton mine, also in Putnam county, arrangements are being perfected for removing a large body of lean magnetite by open cut, for the purpose of concentration.

Wisconsin occupies fifth place with a product in 1890 of 948,965 long tons, or 5.92 per cent. of the entire output of the country. The quantity of red hematite produced was 784,257 long tons, or 82.64 per cent. of the total amount of the iron ore won in this State, and 7.45 per cent. of the total of this kind of ore in the United States. Of the State's output 17.36 per cent., or 164,708 long tons, was brown hematite, being 6.43 per cent. of the country's total of this class of ore. Wisconsin is a larger producer than consumer of iron ores, its furnaces requiring about 45 per cent. of its total output of ores. Owing, however, to the ownership of mines, the character of material won, and the routes of transportation, a large amount of the iron ore used in the furnaces comes from Michigan, while Wisconsin ores seek markets at the lower lake ports. The total output of Wisconsin for a number of years can not be given, as some of the brown hematites in the central portion, and the fossil hematites in the eastern section of the State, are not regularly mentioned in shipping reports. Since 1885, when the Gogebic range made its first output, the following amounts of iron ore were shipped from the mines in Wisconsin, which may be considered as in the Lake Superior region. The freight rates on these ores are those for Ashland, Wisconsin, and Escanaba, Michigan, for the years named.

Total iron ore production and lake freights from Wisconsin mines in the Lake Superior region.

Years.	Iron ore production.	Freight rate by lake vessels per long ton.	
		From Escanaba, Michigan.	From Ashland, Wisconsin.
	Long tons.		
1880	14,143	$1.50 to 2.00	
1881	197,911	1.00 1.60	
1882	276,020	.90 1.40	
1883	62,175	.90 1.50	
1884	34,612	.65	
1885	55,181	1.00	$1.07 to 1.65
1886	150,294	1.35	1.02 3.00
1887	400,104	1.75	1.75 2.75
1888	381,140	.90 1.45	1.02 1.08
1889	(*a*) 837,399	.90 1.25	1.25 .90
1890	(*a*) 948,965	1.10 1.00	1.35 1.00
Total	3,357,944		

a. Including all mines in the State.

Minnesota ranks sixth with a total of 891,910 tons, or 5.56 per cent. of the total iron ore for the country; all of the ore was of the red hematite variety, in which class the State occupied third place, producing 8.47 per cent. of the entire output.

The iron smelting industry of Minnesota has been dormant for a number of years, but a blast furnace has lately been constructed. It was not operated in 1890, and, therefore, no ore was used. The iron ores of Minnesota travel further to reach points of consumption than any other ores in the country. The ores being of the hard red hematite variety, and rich in iron, they stand shipment better than most ores because while in transit they absorb less moisture, which adds to the freight charges on the ore.

The first shipment of iron ore from the Vermilion range was in the year 1884, and since then each year has shown an increased output as will be seen from the accompanying table, which gives the product of the Vermilion range in Minnesota, up to and including 1890, as well as the freight rates from Two Harbors.

Total iron ore production and lake freights from Minnesota mines.

Years.	Production.	Freight rate by lake vessel per long ton, from Two Harbors, Minnesota.
	Long tons.	
1884	63,122	
1885	227,075	
1886	307,948	
1887	394,910	
1888	511,953	$1.02 to 1.66½
1889	(*a*) 864,508	1.25 1.90
1890	891,910	1.35 1.10
Total	3,260,426	

a Eleventh Census.

Virginia had an output of 543,583 long tons or 3.39 per cent. of the total product of iron ore in 1890. The major portion, viz, 522,908 long tons, or 96.20 per cent., was brown hematite, this State heading the list of producers of that character of ore, its proportion being 20.43 per cent. The State held tenth position in the list of red hematite producers with 16,212 tons, or 2.98 per cent. of the State's product, or 0.15 per cent. of the entire red hematite product, and standing seventh as a producer of magnetite with a percentage of 0.17. Lately there has been an active development of blast furnace construction in Virginia, causing additional demands on the iron-ore mines. While ores have been sent from Virginia into other States, the bulk of what is mined, is, and will be, required and used in the State, and it is probable that other ores may be drawn into it from North Carolina and elsewhere.

New Jersey stands eighth, producing 495,808 tons, or 3.09 per cent. of the total iron ore for the United States, all of the ore being magnetite with the exception of 6,000 tons, or 1.21 per cent., which was red hematite. It produced 19.05 per cent. of the total magnetite mined, and 0.06 per cent. of the red hematites, ranking third and twelfth, respectively, in these classes. While the New Jersey blast furnaces use local magnetites, with the addition of some foreign ore, a large part of the output from the mines is sent to the Pennsylvania furnaces.

The table which follows gives the total production of iron ore in New Jersey up to and including 1890, and has been compiled from the reports of the New Jersey Geological Survey.

Total production of the iron-ore mines of New Jersey.

Years.	Long tons.	Years.	Long tons.
Prior to 1860	(a)6,000,000	1880	745,000
1860	164,900	1881	737,052
1864	226,000	1882	932,762
1867	275,067	1883	521,416
1870	362,636	1884	393,710
1871	450,000	1885	330,000
1872	600,000	1886	500,501
1873	665,000	1887	547,889
1874	525,000	1888	447,738
1875	390,000	1889	(b) 415,510
1876	285,000	1890	(c) 495,808
1877	315,000		
1878	409,674	Total	17,223,691
1879	488,028		

a Estimated. *b* Eleventh Census. *c* U. S. Geological Survey.

The output of iron ore in Tennessee was 465,695 long tons or 2.90 per cent. of the total for the country in 1890. Of this amount the red hematite mines contributed 278,076 tons, or 59.71 per cent., and the brown hematite 187,619 tons, or 40.29 per cent. This State occupied fifth place as a red hematite producer, its percentage being 2.64 and fifth place with 7.33 per cent. in the brown hematite class. Nearly all of the iron ore mined is consumed in the blast furnaces of the State, and in addition some iron ore is brought in from Georgia.

Georgia's product is 244,088 tons or 1.52 per cent. of the total iron ore for the country, the larger portion, 71.62 per cent., being brown hematite, in which class it takes sixth rank, with 6.83 per cent. of the total of that class; the remainder of the State's output, 28.38 per cent., or 69,271 tons, is red hematite, which amount gives it ninth rank, with a percentage of the total of 0.66. Georgia made pig iron from about one-half of the ores mined in the State, the balance being shipped to Tennessee and Alabama.

Missouri's output of 181,690 tons of iron ore gives it eleventh position, its percentage being 1.13. Of this 87.75 per cent. or 159,440 tons, is red hematite, this amount giving it seventh position in that class of ore, with a percentage of the country's total of 1.51. The remainder, 22,250 tons, or 12.25 per cent. of the State's output, was brown hematite, in which class of ore it obtained fourteenth position, its percentage being 0.87 of the total mined.

The blast furnaces of Missouri use more than one-half of its iron-ore output. The remainder is sent to various States, some of it being employed in silver-smelting. The practical abandonment of one prominent ore-producer has had a depressing influence upon the possible future of other similar deposits, but later exploration of territory adjacent to this abandoned mine indicates large reserves of ore which can be depended upon when the demand shall encourage the exploitations being carried to sufficient depths.

In "Mineral Resources of the United States, 1887," the output of the Iron Mountain deposit up to 1887 was given as 2,736,445 tons; subsequent exploitations have increased this amount to 3,282,391 long tons.

On subsequent pages will be found an interesting summary of the chemical investigation of the Iron Mountain ores, covering one year of close examination.

Ohio ranks twelfth as a producer; it is the only other State producing over 1 per cent. of the total for the country, its proportion being 1.05, all of which is carbonate ore. It was the largest producer of this class of ore in the country, its percentage of the total output being 44.78. Nearly, if not all, of this ore is smelted in local blast furnaces, but it forms only a small proportion of the supply, the balance coming from the Lake Superior region, Missouri, Kentucky, and even from New York. In this respect Ohio is the opposite of Michigan, which consumes but a small percentage of its output, shipping the balance to other points. Ohio is a large user of Michigan ores and ranks next to Pennsylvania as a consumer of iron ores.

Production of carbonate iron ore in Ohio from 1886 to 1890.

Years.	Amount mined.
	Long tons.
1886	(a) 344,484
1887	(a) 377,465
1888	(a) 253,352
1889	254,294
1890	169,088
Total for five years	1,398,683

a Reports of the chief inspector of mines of the State of Ohio.

None of the remaining States produced a large amount of ore, their combined percentage being but 2.75. In the western States a majority of the ore won is brown hematite, which is used in smelting the precious metals, although there were active blast furnaces in Colorado and Oregon in 1890.

Kentucky uses some of her ores in local blast furnaces and also sends some to furnaces in Ohio.

Maryland uses the bulk of her own ores, carbonates, and brown hematites, although some were sent to Pennsylvania.

The brown hematites of Massachusetts, Connecticut, and New York, chiefly those from the Salisbury district, are sought after by local furnaces, but the output of the mines is comparatively small.

West Virginia uses all of the ore produced there and also obtains liberal supplies from the Lake Superior region and Missouri.

North Carolina magnetites are used in the local furnace, and also sent to other plants outside of the State. In addititiion to the magnetite, which is already developed, red and brown hematites exist and are being developed.

Texas as yet only mines bog ores for a limited home consumption.

The only blast furnace in the State of Maine suspended operations in 1890, and it is scarcely probable that the iron ore mines will be operated in the near future.

A deposit of bog ore occurs in Delaware, from which ore has been won for many years, and which will probably be again worked.

In Florida a deposit of carbonate ore has been explored with a view to working it, but the project has not been carried out.

Years ago South Carolina contributed to the iron-ore supply of the country and has some good deposits.

Mississippi, Louisiana, and Texas furnish some carbonates and brown hematites from surface strippings, but large areas must be exposed to win any considerable quantity of ore.

Wyoming is favored with unusually excellent deposits of iron ores; Indian Territory holds in reserve considerable bodies of ore; California, Washington, and most of the western States have supplies of excellent ores, which can be used in the future.

TOTAL PRODUCTION OF PROMINENT IRON ORE DISTRICTS.

The Lake Superior district is by far the most important producer of iron ores, and not only now supplies more iron ore than any other section of the country, but has up to the present time contributed more than any other section. In the following statement an effort has been made to give approximately the total output of various producing centers:

Total production of iron ore in prominent producing centers.

		Long tons.
Lake Superior region		57,000,000
Of which Marquette district supplied	32,700,000	
Menominee district supplied	12,800,000	
Gogebic district supplied	8,300,000	
Vermilion district supplied	3,200,000	
Lake Champlain region, New York		16,600,000
Of which Port Henry supplied	10,000,000	
Crown Point supplied	1,800,000	
Chateaugay supplied	2,550,000	
Other mines supplied	2,250,000	
New Jersey		17,200,000
Cornwall		10,850,000
Missouri		5,780,000
Of which Iron Mountain supplied	3,280,000	
Pilot Knob and other Missouri mines supplied	2,500,000	

COMPARATIVE PRODUCTION OF IRON ORE IN 1880, 1889, AND 1890, IN PROMINENT STATES.

The tables which follow have been prepared to illustrate the changes which have taken place within the last decade, in the quantities of each class of ore, and of all kinds produced by each contributing State, and also the increase or decrease which has occurred in ten years and in one year, viz, 1889 to 1890. In these tables the published reports of the Tenth and Eleventh Censuses are used, and the figures from these are compared with those collected for 1890 for the present volume of Mineral Resources. The relative importance or rank of each State as a producer is given with the figures for each year.

Production of iron ores by States in 1890, 1889, and 1880, with percentages of increase or decrease.

States.	1890.			1889.		
	Rank.	Production.	Percentage of total.	Rank.	Production.	Percentage of total.
		Long tons.			*Long tons.*	
Michigan	1	7,141,656	44.54	1	5,856,169	40.34
Alabama	2	1,897,815	11.83	2	1,570,319	10.82
Pennsylvania	3	1,361,622	8.50	3	1,560,234	10.75
New York	4	1,253,393	7.82	4	1,247,537	8.59
Wisconsin	5	948,965	5.92	6	837,399	5.77
Minnesota	6	891,910	5.56	5	864,508	5.95
Virginia	7	543,583	3.39	7	498,154	3.43
New Jersey	8	495,808	3.09	9	415,510	2.86
Tennessee	9	465,695	2.90	8	473,294	3.26
Georgia	10	244,088	1.52	12	248,020	1.71
Missouri	11	181,690	1.13	10	265,718	1.83
Ohio	12	169,088	1.05	11	254,294	1.75
Colorado	13	114,275	0.71	13	109,136	0.75
Montana, Oregon, New Mexico, and Utah	14	81,632	0.51	14	(*a*) 86,405	0.60
Kentucky	15	77,685	0.48	15	77,487	0.53
Maryland	16	35,657	0.22	18	(*b*) 29,380	0.20
Massachusetts	17	32,934	0.21	16	46,242	0.32
Connecticut	18	26,058	0.16	17	29,690	0.20
West Virginia	19	25,116	0.16	19	13,101	0.09
North Carolina	20	22,873	0.14	22	10,125	0.07
Texas	21	22,000	0.14	20	13,000	0.09
Maine	22	2,500	0.02	21	12,319	0.09
Indiana and Vermont	......	....	....	......	....	....
Total	......	16,036,043	100.00	......	14,518,041	100.00

a Including Idaho and Washington.

b Including Delaware.

Production of iron ores by States in 1890, 1889, and 1880, etc.—Continued.

States.	1880.			Increase or decrease in 1890 over 1889.	Percentage of increase or decrease in 1890 over 1889.	Increase or decrease in 1890 over 1880.	Percentage of increase or decrease in 1890 over 1880.
	Rank.	Production.	Percentage of total.				
		Long tons.		*Long tons.*		*Long tons.*	
Michigan	2	1,640,814	23.04	+1,285,487	+ 21.97	+5,500,842	+ 335.25
Alabama	8	171,139	2.40	+ 327,496	+ 20.86	+1,726,676	+1008.93
Pennsylvania	1	1,951,495	27.41	— 198,612	— 12.73	— 589,873	— 30.23
New York	3	1,126,899	15.83	+ 5,856	+ 0.47	+ 126,494	+ 11.22
Wisconsin	15	37,000	0.52	+ 111,566	+ 13.32	+ 911,965	+2464.77
Minnesota	......	None.	....	+ 27,402	+ 3.17	+ 891,910	....
Virginia	7	162,791	2.29	+ 45,429	+ 9.12	+ 380,792	+ 233.91
New Jersey	4	676,225	9.50	+ 80,298	+ 19.33	— 180,417	— 26.68
Tennessee	10	93,272	1.31	— 7,599	— 1.61	+ 372,423	+ 399.29
Georgia	11	81,621	1.15	— 3,932	— 1.61	+ 162,467	+ 199.05
Missouri	6	344,819	4.84	— 84,028	— 31.62	— 163,129	— 47.31
Ohio	5	488,753	6.86	— 85,206	— 33.51	— 319,665	— 65.40
Colorado	......	None.	....	+ 5,139	+ 4.71	+ 114,275	....
Montana, Oregon, New Mexico, and Utah	17	(*a*) 6,225	0.09	— 4,773	— 5.52	+ 75,407	+1211.36
Kentucky	12	57,865	0.81	+ 198	+ 0.26	+ 19,820	+ 34.25
Maryland	9	(*b*) 127,102	1.78	+ 6,277	+ 21.36	— 91,445	— 71.95
Massachusetts	13	55,926	0.79	— 13,308	— 28.78	— 22,992	— 41.11
Connecticut	16	31,267	0.44	— 3,632	— 12.23	— 5,209	— 16.66
West Virginia	14	54,657	0.77	+ 12,015	+ 91.71	— 29,541	— 54.05
North Carolina	20	2,963	0.04	+ 12,748	+125.91	+ 19,910	+ 671.95
Texas	19	3,214	0.05	+ 9,000	+ 69.23	+ 18,786	+ 584.51
Maine	18	5,357	0.07	— 9,819	— 79.71	— 2,857	— 53.33
Indiana and Vermont	21	958	0.01	....	....	— 958	— 100.00
Total	......	7,120,362	100.00	+1,518,002	+ 10.46	+8,915,681	+ 125.21

a Only Oregon. *b* Including Delaware.

The above table treats of the aggregate of all kinds of ore mined, and indicates that the producing States in 1880 numbered twenty-three; in 1889, twenty-six States and two Territories, and in 1890, twenty-three States and two Territories. The total output of iron ore in ten years increased over 125 per cent, and the production of 1890 was over 10 per cent greater than that of 1889.

Pennsylvania was the largest contributor to the iron-ore supply of 1880, with 27.41 per cent of the total. In ten years its output has decreased over half a million tons, a decline of 30 per cent, and the State in 1889 and 1890 ranks third in importance, following Michigan and Alabama. As above stated, Pennsylvania local ores have been largely displaced by foreign ores, or by those from the Lake Superior region. Although a smaller producer of iron ores, Pennsylvania has been a growing consumer, and now requires a supply of iron ores which is equivalent to nearly 54 per cent of what the country produced in 1890.

Michigan, which held second rank in 1880, producing 23.04 per cent of the total, more than quadrupled its output in a decade, rising to first place and contributing in 1889 40.34 per cent, and in 1890 44.54 per cent of the total of the country. An increase of five and a half million tons in ten years is remarkable, but an augmented output exceeding one and a quarter million tons in one year is even more unusual, as shown by the production of Michigan for 1890 exceeding that for 1889 by almost 22 per cent. The number, the character, and the extent of the iron-ore deposits of the State, the improved mining appliances, and the excellent transportation facilities established, give promise that Michigan will continue to lead other States as a producer of iron ores.

New York, which held third place in 1880, augmented its output so as to show an increase of 11.22 per cent in ten years, but the greater advance in other States forced New York to occupy fourth rank in 1889 and 1890. This State should be able to maintain its present position with the large deposits of good magnetite available and the possibilities of augmented output from these by ore which is beneficiated by magnetic separators. There was a decline in the amount of brown hematite produced in New York in 1890 and 1889 as compared with 1880.

New Jersey, for similar reasons, should in the future show an improvement, for although standing fourth in importance in 1880, and producing nearly one-tenth of the iron ore in that year, it fell to ninth place in 1889, recovering eighth position in 1890, and producing but 3 per cent of the country's total, showing a decline of production in a decade of 26.68 per cent. Some of the influences which affected the iron-ore output of Pennsylvania were active in New Jersey.

Ohio, even more than New Jersey, shows unfavorably in a comparison between the outputs for 1880, 1889, and 1890 occupying fifth place and producing nearly 7 per cent of the total in 1880, the State ranked eleventh in 1889 and twelfth in 1890, with an output of but 1 per cent of the country's total in the latter year, the decline in a decade being 65.4 per cent, owing to the displacement of local carbonate iron ores by richer ores from the Lake Superior region. Ohio, however, ranks second only to Pennsylvania as a consumer of iron ores.

Missouri is another instance of decreased production, more noted than New Jersey, but less than Ohio, except in the years 1889 and 1890. This State, whose output of iron ore in 1880 was nearly 5 per cent of the country's total, giving it sixth rank, contributed less than 2 per cent in 1889 and 1½ per cent in 1890 of the totals in those years. The decline in ten years was 47.31 per cent, due to a contraction of the iron-smelting industry of the State and the practical exhaustion of one important iron-ore mine.

Virginia, which stood next to Missouri in 1880, and contributed 2.29 per cent of the total iron ore for the country in that year, has maintained the same relative rank (viz, seventh), although the production of 1880 was more than trebled in both 1889 and 1890, the proportions of the total iron-ore output which the State contributed in these years being 3.43 per cent and 3.39 per cent, respectively. The State did not quite keep pace with the entire country in the proportionate increased production of 1890 over 1889. The construction of numerous blast furnaces in Virginia offers indications for continued activity in its iron-ore mines.

Alabama shows more remarkable growth than Virginia, its output of 1880, which was 2.4 per cent of the country's production in that year, being increased nine and ten fold, respectively, in 1889 and 1890, when the percentages of the total output represented by Alabama's contribution were 10.82 and 11.83 per cent. The rapid increase in the iron-producing industries of the State have encouraged an unusual development of iron-ore deposits; and Alabama, which was a comparatively unimportant producer of iron ore (ranking eighth in 1880), has risen to second place in 1889, maintaining this position with increased output in 1890.

Maryland shows a material decline in ten years, for, like Ohio, the abandonment of its local carbonate deposits has reduced its iron-ore output from 1.78 to 0.22 per cent of the country's total, driven it from ninth to sixteenth rank, and indicated a reduction of 71.95 per cent in production. A similar result is noticed in West Virginia, with a decline of 54 per cent in ten years. These two States, however, are important consumers of iron ore.

Tennessee, Georgia, and Kentucky, which held tenth, eleventh, and twelfth places in 1880, showed an increased production in 1890, fivefold, threefold, and one-third, respectively, giving the States named ninth, tenth, and fifteenth ranks.

On the other hand, Massachusetts, Connecticut, and Maine, which in 1880 combined supplied 1.3 per cent of the total for the country, each show a decided decline; and their combined output was but 0.61 per cent of the nation's production of iron ore in 1889, and 0.39 per cent in 1890.

The development of a large deposit of magnetite in North Carolina has caused an advance in that State, but it has not reached the important position it should command.

Texas has commenced the development of its bog ores, but it is not probable that it will reach a production equivalent to 1 per cent of the country's total for several years.

The most marked advances in the past decade appear in the States of Wisconsin, Minnesota, Colorado, and those States west of the Rocky Mountains.

Wisconsin, which ranked fifteenth in 1880, mining ores principally for local charcoal blast furnaces, increased its output in 1890 twenty-five fold, to nearly 1,000,000 tons, taking fifth rank as a producer. Only three States, Pennsylvania, Michigan, and New York, produced more iron ore in 1880 than Wisconsin did in 1890. This advance is chiefly due to the development, within six years, of the Gogebic iron range in Michigan and Wisconsin.

Minnesota, which did not appear in the record of 1880 as a producer of iron ore, followed Wisconsin closely in 1890 in sixth rank, with a production only excelled by three States a decade ago. The exploitation of the Vermilion iron range in Minnesota, contemporaneously with that of the Gogebic range, has brought this State into prominence as an iron-ore producer, a position which it will probably maintain in the future.

Colorado, which was not reported among the producers of iron ore in 1880, ranks thirteenth in 1890, with an output which was supplied to blast furnaces and silver smelters. This State would have ranked as a large producer ten years ago with the amount of iron ore which is credited to it in 1890, and the local developments will probably keep it as a contributor of a greater percentage than in 1890 (0.71) of the total output.

Oregon, the only far Western State which furnished iron ores in 1880, has been joined since by Washington, Utah, New Mexico, Montana, and Idaho. The combined outputs of these States and Territories in 1890 represented one-half of 1 per cent of the total production of the country. The amount was somewhat greater in 1889, for Idaho and Washington were producers in that year, but were not so reported in 1890.

Production of red hematite ores, by States, in 1890, 1889, and 1880, with percentages of increase or decrease.

States.	1890.			1889.		
	Rank.	Production.	Percentage of total.	Rank.	Production.	Percentage of total.
		Long tons.			*Long tons.*	
Michigan	1	6,426,077	61.04	1	5,272,915	58.22
Alabama	2	1,538,297	14.61	2	1,190,985	13.15
Minnesota	3	891,910	8.47	3	864,508	9.55
Wisconsin	4	784,257	7.45	4	735,429	8.12
Tennessee	5	278,076	2.64	5	299,102	3.30
New York	6	196,035	1.86	7	224,438	2.48
Missouri	7	159,440	1.51	6	265,318	2.93
Pennsylvania	8	143,745	1.37	8	162,957	1.80
Georgia	9	69,271	0.66	10	12,963	0.14
Virginia	10	16,212	0.15	11	8,746	0.10
Colorado	11	14,698	0.14	12	4,821	0.05
New Jersey	12	6,000	0.06	......	....	....
Montana, Oregon, New Mexico, and Utah	13	3,632	0.04	9	14,106	0.16
Total	......	10,527,650	100.00	......	9,056,288	100.00

States.	1880.			Increase or decrease in 1890 over 1889.	Percentage of increase or decrease in 1890 over 1889.	Increase or decrease in 1890 over 1880.	Percentage of increase or decrease in 1890 over 1880.
	Rank.	Production.	Percentage of total.				
		Long tons.		*Long tons.*		*Long tons.*	
Michigan	1	1,213,479	54.09	+1,153,162	+ 21.87	+5,212,598	+ 429.56
Alabama	6	67,159	2.99	+ 347,812	+ 29.16	+1,471,138	+2,190.53
Minnesota	......	....	....	+ 27,402	+ 3.17	+ 891,910	....
Wisconsin	9	35,000	1.55	+ 48,828	+ 6.64	+ 749,257	+2,140.73
Tennessee	5	68,358	3.04	— 21,026	— 7.03	+ 209,718	+ 306.79
New York	4	160,899	7.17	— 28,403	— 12.66	+ 35,136	+ 21.84
Missouri	2	344,719	15.36	— 105,878	— 39.91	— 185,279	— 53.75
Pennsylvania	3	267,572	11.93	— 19,212	— 11.79	— 123,827	— 46.28
Georgia	8	42,148	1.88	+ 56,308	+434.38	+ 27,123	+ 64.35
Virginia	7	37,000	1.65	+ 7,466	+ 85.36	— 20,788	— 56.18
Colorado	......	....	....	+ 9,877	+204.87	+ 14,698	....
New Jersey	......	....	....	+ 6,000	....	+ 6,000	....
Montana, Oregon, New Mexico, and Utah	......	....	....	— 10,474	— 74.25	+ 3,632	....
West Virginia	10	6,250	0.28	....	....	— 6,250	— 100.00
Maryland	11	909	0.04	....	....	— 909	— 100.00
Vermont	12	500	0.02	....	....	— 500	— 100.00
Total	......	2,243,993	100.00	+1,471,362	+ 16.25	+8,283,657	+ 369.15

The table above illustrates the rank and comparative development of the various States in the production of red hematite ores, the class which in ten years has advanced most rapidly. The table shows that the increase has been chiefly in the rich red hematite of Michigan, Wisconsin, and Minnesota, and in the easily mined fossil ores of Alabama and Tennessee. New York and Georgia also show an advance, while Missouri and Pennsylvania exhibit a decline, due in the former State to depletion of available or easily wrought deposits, and in the latter to expensive mining of lean ores. The deposits of Maryland, West Virginia, and Vermont were not wrought in 1890.

Michigan, Wisconsin, Minnesota, and Alabama supplied over 90 per cent of all the red hematites mined in the country in 1890, whereas in 1880 the same territory contributed less than 60 per cent of the total of this class of ore. On the other hand, Pennsylvania and Missouri, which combined produced over 27 per cent of all of the red hematites in 1880, have in ten years declined in quantity more than one-half, and in 1890 these two States supplied less than 3 per cent of the red hematite mined in the United States.

Production of brown hematite ore, by States, in 1890, 1889, and 1880, with percentages of increase or decrease.

States.	1890.			1889.		
	Rank.	Production.	Percentage of total.	Rank.	Production.	Percentage of total.
		Long tons.			*Long tons.*	
Virginia	1	522,908	20.43	2	483,208	19.15
Pennsylvania	2	415,779	16.24	1	496,555	19.68
Michigan	3	402,274	15.71	4	332,257	13.17
Alabama	4	359,518	14.04	3	379,334	15.03
Tennessee	5	187,619	7.33	6	174,192	6.90
Georgia	6	174,817	6.83	5	235,057	9.32
Wisconsin	7	164,708	6.43	7	101,970	4.04
Colorado	8	99,577	3.89	8	100,421	3.98
Montana, Oregon, New Mexico, and Utah	9	48,000	1.88	10	37,763	1.50
Massachusetts	10	32,934	1.29	9	46,242	1.83
New York	11	30,968	1.21	11	30,374	1.20
Connecticut	12	26,058	1.02	12	29,690	1.18
Maryland	13	23,343	0.91	14	16,160	0.64
Missouri	14	22,250	0.87	21	400	0.02
Texas	15	22,000	0.86	15	13,000	0.51
Kentucky	16	15,685	0.61	13	25,212	1.00
West Virginia	17	9,000	0.35	17	4,000	0.16
Maine	18	2,500	0.10	16	12,319	0.49
Delaware	......	....	....	19	1,901	0.08
Idaho	......	....	....	20	1,104	0.04
Washington	......	....	....	18	1,928	0.08
Total	......	2,559,938	100.00	......	2,523,067	100.00

Production of brown hematite ore, by States, in 1890, 1889, and 1880, etc.—Continued.

States.	1880. Rank.	1880. Production.	1880. Percentage of total.	Increase or decrease in 1890 over 1889.	Percentage of increase or decrease in 1890 over 1889.	Increase or decrease in 1890 over 1880.	Percentage of increase or decrease in 1890 over 1889.
		Long tons.		*Long tons.*		*Long tons.*	
Virginia	4	115,246	6.01	+39,700	+ 8.22	+407,662	+ 353.73
Pennsylvania	1	1,009,550	52.62	—80,776	— 16.27	—593,771	— 58.82
Michigan	2	294,551	15.35	+70,017	+ 21.07	+107,723	+ 36.57
Alabama	5	98,836	5.15	—19,816	— 5.22	+260,682	+ 263.75
Tennessee	10	24,914	1.30	+13,427	+ 7.71	+162,705	+ 653.07
Georgia	8	39,473	2.06	—60,240	— 25.63	+135,344	+ 342.88
Wisconsin	18	2,000	0.10	+62,738	+ 61.53	+162,708	+ 8,135.40
Colorado	......	......	......	— 844	— 0.84	+ 99,577	......
Montana, Oregon, New Mexico, and Utah	13	*a* 6,225	0.32	+10,237	+ 27.11	+ 41,775	+ 671.08
Massachusetts	7	55.926	2.92	—13,308	— 28.78	— 22,992	— 41.11
New York	3	138,275	7.21	+ 594	+ 1.96	—107,307	— 77.60
Connecticut	9	31,267	1.63	— 3,632	— 12.23	— 5,209	— 16.66
Maryland	6	57,821	3.01	+ 7,183	+ 44.45	— 34,478	— 59.80
Missouri	21	100	0.01	+21,850	+5,462.50	+ 22,150	+22,150.00
Texas	15	3,214	0.17	+ 9,000	+ 69.23	+ 18,786	+ 584.51
Kentucky	11	15,768	0.82	— 9,527	— 37.79	— 83	— 0.53
West Virginia	17	2,900	0.15	+ 5,000	+ 125.00	+ 6,100	+ 210.34
Maine	14	5,357	0.28	— 9,819	— 79.71	— 2,857	— 53.31
New Jersey	12	13,846	0.72	......	......	— 13,846	— 100.00
Delaware	16	2,434	0.13	— 1,901	— 100.00	— 2,434	— 100.00
Idaho	......	......	......	— 1,104	— 100.00	......	......
Washington	......	......	......	— 1,928	— 100.00	......	......
North Carolina	19	461	0.02	......	......	— 461	— 100.00
Indiana	20	458	0.02	......	......	— 458	— 100.00
Total	......	1,918,622	100.00	+36,851	+ 1.46	+641,316	+ 83.43

a Oregon only.

The table above exhibits the rank of various States as producers of brown hematite ores, showing a material decline in the amount produced in Pennsylvania and in all of the Eastern States, and a marked advance in Virginia, Alabama, and in all of the Southern States except Kentucky, also an increase in quantity in Michigan and Wisconsin, where some hydrated ores occur with red hematites, and where large deposits of limonites have lately been exploited. Brown hematites will not permit of such long hauls as most red hematites and magnetites, and hence depend more on local consumption.

The table which follows indicates an advance in the production of magnetite of but 20 per cent in ten years. Pennsylvania, however, increased its output over 70 per cent in 1889, and 53 per cent in 1890 over the returns for 1880, chiefly on account of the development of the Cornwall Ore Hills. New York shows a gradual increase, the output of 1890 exceeding that of 1880 by 14.18 per cent. The quantitative decline in New Jersey is offset by a nearly similar increase in Michigan. As in other tables the ranks of the various States in 1880, 1889, and 1890 are shown.

Production of magnetite by States in 1890, 1889, and 1880, with percentages of increase or decrease.

States.	1890.			1889.		
	Rank.	Production.	Percentage of total.	Rank.	Production.	Percentage of total.
		Long tons.			*Long tons.*	
New York	1	945,071	36.76	1	927,269	37.00
Pennsylvania	2	765,318	29.77	2	860,916	34.35
New Jersey	3	489,808	19.05	3	415,510	16.58
Michigan	4	313,305	12.19	4	250,997	10.01
Montana, Oregon, New Mexico, and Utah	5	30,000	1.17	5	31,504	1.26
North Carolina	6	22,873	0.89	6	10,125	0.40
Virginia	7	4,463	0.17	7	6,200	0.25
Colorado	......	......	......	8	3,894	0.15
Maryland	......	......	......	......	......	......
Total	......	2,570,838	100.00	......	2,506,415	100.00

States.	1880.			Increase or decrease in 1890 over 1889.	Percentage of increase or decrease in 1890 over 1889.	Increase or decrease in 1890 over 1880.	Percentage of increase or decrease in 1890 over 1880.
	Rank.	Production.	Percentage of total.				
		Long tons.		*Long tons.*		*Long tons.*	
New York	1	827,725	38.78	+ 17,802	+ 1.92	+ 117,346	+ 14.18
Pennsylvania	3	498,146	23.34	− 95,598	− 11.10	+ 267,172	+ 53.63
New Jersey	2	662,379	31.04	+ 74,298	+ 17.88	− 172,571	− 26.05
Michigan	4	132,785	6.22	+ 62,308	+ 24.82	+ 180,520	+ 135.95
Montana, Oregon, New Mexico, and Utah	......	......	......	− 1,504	− 4.77	+ 30,000	......
North Carolina	6	2,501	0.12	+ 12,748	+125.91	+ 20,372	+ 814.56
Virginia	5	10,545	0.49	− 1,737	− 28.02	− 6,082	− 57.68
Colorado	......	......	......	− 3,894	−100.00	......	......
Maryland	7	195	0.01	......	......	− 195	− 100.00
Total	......	2,134,276	100.00	+ 64,423	+ 2.57	+ 436,562	+ 20.45

The following table shows the disfavor which has been exhibited to the use of carbonate ores, the only increase being in New York, where a large deposit, opened since 1880, has contributed to the supply, and in Kentucky, where a local demand has encouraged exploitations. Ohio shows a decided decline, greater in quantity, but proportionately less, than is exhibited by Pennsylvania and Maryland.

Production of carbonate ore by States in 1890, 1889, and 1880, with percentages of increase or decrease.

States.	1890.			1889.		
	Rank.	Production.	Percentage of total.	Rank.	Production.	Percentage of total.
		Long tons.			*Long tons.*	
Ohio	1	169,088	44.78	1	254,294	58.83
New York	2	81,319	21.53	2	65,456	15.14
Kentucky	3	62,000	16.42	3	52,275	12.09
Pennsylvania	4	36,780	9.74	4	39,806	9.21
West Virginia	5	16,116	4.27	6	9,101	2.11
Maryland	6	12,314	3.26	5	11,319	2.62
Alabama	......	......	......	......	......	......
Total	......	377,617	100.00	......	432,251	100.00

Production of carbonate ore by States in 1890, 1889, and 1880, etc.—Continued.

States.	1880.			Increase or decrease in 1890 over 1889.	Percentage of increase or decrease in 1890 over 1889.	Increase or decrease in 1890 over 1880.	Percentage of increase or decrease in 1890 over 1880.
	Rank.	Production.	Percentage of total.				
		Long tons.		*Long tons.*		*Long tons.*	
Ohio	1	488,753	59.35	−85,206	−33.51	−319,665	−65.40
New York	......	....	......	+15,863	+24.23	+81,319	....
Kentucky	5	42,096	5.11	+9,725	+18.60	+19,904	+47.28
Pennsylvania	2	176,227	21.40	−3,026	−7.60	−139,447	−79.13
West Virginia	4	45,507	5.53	+7,015	+77.08	−29,391	−64.59
Maryland	3	65,743	7.98	+995	+8.79	−53,429	−81.27
Alabama	6	5,145	0.63	....	....	−5,145	−100.00
Total	......	823,471	100.00	−54,634	−12.64	−445,854	−54.14

As carbonates must be roasted before being charged into the blast furnace, and as their occurrence is generally in thin but continuous seams, or in scattered pockets, the large territory which must be uncovered to secure a comparatively small tonnage makes the cost of the ore per unit of iron excessive, and where richer ores are available they displace the carbonates.

IMPORTATIONS OF IRON ORES.

The table below gives the quantities of iron ore in long tons imported into the United States, the value of such importations during the years 1889 and 1890, also the countries from which the ore was forwarded. The point of shipment reported is not necessarily in the country where the ore was mined, but an examination of the table gives no reason to credit any of the ore elsewhere than to the countries named in the table. The unusual values given to some of the smaller importations are owing to the ore having some especially valuable constituent in addition to the iron. The amount of iron ore imported in 1890 was considerably in excess of that of 1889, and the quantity brought into the country in 1890 was greater than in any previous year. Spain and Cuba supplied the bulk of the foreign ore in each year.

Imports of iron ore in 1889 and 1890 by countries.

Countries.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Spain	298,568	$621,481	512,933	$1,099,081
Cuba	243,255	535,524	351,814	778,895
French Africa	97,583	180,697	96,428	188,360
Italy	87,410	228,164	134,399	393,280
England	54,496	111,638	51,857	155,275
Greece	23,955	32,880	48,807	87,397
Newfoundland and Labrador	14,450	43,100	6,320	18,960
British Columbia	13,670	27,860	....	....
Portugal	6,659	15,151	16,526	36,941
France	6,565	17,911	2,404	5,647
Quebec, Ontario, Manitoba, and Northwest Territory	4,091	10,697	22,211	57,667
Turkey in Asia	2,870	27,265	3,078	32,345
Germany	1	24	....	....
Brazil	....	....	52	300
Mexico	....	....	1	20
Total	853,573	1,852,892	1,246,830	2,854,118

The figures in the foregoing table indicate that none of the States except Michigan, Alabama, Pennsylvania and New York contributed as much iron ore in 1890 as was imported, and this amount was only slightly less than the production of the latter State; that Spain supplied more ore to this country than the State of New Jersey, and somewhat less than Virginia; that Cuba's contribution was in excess of that of Georgia, occupying a middle position between the outputs of Georgia and Tennessee; that from Italy more ore was brought to this country than was furnished by Colorado; that Africa was credited with four-fifths of Colorado's output, and three times that of Massachusetts. The exportations of iron ore from England to this country equaled the outputs of Connecticut and West Virginia combined, while that of Greece exceeded the total of North Carolina and Texas.

The following table is a companion to that above, the quantities and values being divided in accordance with the ports of the United States at which the foreign iron ores were received.

Imports of iron ore by ports of entry in 1889 and 1890.

Ports.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Philadelphia, Pennsylvania	525,124	$1,192,141	683,665	$1,641,654
Baltimore, Maryland	273,050	519,736	481,250	1,015,093
New York, New York	25,824	72,297	38,717	101,908
Puget Sound, Washington	13,670	27,860	....	....
Perth Amboy, New Jersey (*a*)	11,558	26,075	25,524	50,984
Oswego, New York	2,309	6,353	12,617	23,446
Cuyahoga, Ohio	1,224	3,403	4,675	15,460
Vermont district	462	707	239	258
Pensacola, Florida	135	608	....	....
Buffalo Creek, New York	78	198	82	185
San Francisco, California	61	2,525	60	5,110
Boston, Massachusetts	50	283	....	....
Detroit, Michigan	18	36	....	....
Chicago, Illinois	5	58	....	....
Pittsburg, Pennsylvania	4	88	....	....
St. Louis, Missouri	1	24	....	....
San Diego, California	....	....	1	20
Total	853,573	1,852,392	1,246,830	2,854,118

a This port may also be classed under the head of ports of New York Harbor.

The above table shows that one-half as much foreign iron ore was received at Philadelphia in 1890 as the State of Pennsylvania produced, and the imported ore received at Baltimore was nearly 80 per cent of the combined outputs of the mines of Maryland, West Virginia, and Virginia in the same year.

As a further illustration, a table is given showing a summary of the ports of entry by groups.

Receipts of foreign iron ore, by groups of ports.

Ports.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Atlantic	835,741	$1,811,140	1,241,773	$2,833,085
Lake	3,634	10,048	4,757	15,645
Pacific	13,731	30,385	61	5,130
Miscellaneous	467	819	239	258
Total	853,573	1,852,392	1,246,830	2,854,118

The above table emphasizes the fact that the amount of foreign iron ore received at Atlantic ports was very close to the output of domestic iron ores in New York State, and nearly 90 per cent of the quantity produced in all of the Atlantic States, excepting New York and Pennsylvania.

In "Mineral Resources of the United States, 1886," pp. 99 and 100, there appears a statement showing the quantities of pig iron produced in various prominent countries, in connection with the amounts of foreign iron ores consumed in these countries, to illustrate the apparent average consumption of foreign iron ores used per ton of pig iron made. This statement, as far as it relates to the United States, is here repeated and brought down to date.

Relation between the foreign iron ore imported into, and the pig iron made in, the United States.

Years.	Pig iron made.	Iron ore imported.	Average amount of ore imported per ton of iron produced.
	Long tons.	*Long tons.*	
1879	2,741,853	284,141	.104
1880	3,835,191	493,408	.129
1881	4,144,254	782,887	.189
1882	4,623,323	589,655	.128
1883	4,595,510	490,875	.107
1884	4,097,868	487,820	.109
1885	4,004,526	390,786	.086
1886	5,683,329	1,039,433	.183
1887	6,417,418	1,194,301	.183
1888	6,489,738	587,470	.091
1889	7,603,642	853,573	.112
1890	9,202,703	1,246,830	.135
Total	63,439,355	8,441,179	....
Average for twelve years	5,286,613	703,432	.133

CONCENTRATION OF IRON ORES.

Since the contribution upon the subject of iron ores was prepared for the 1887 volume of Mineral Resources, a lively interest has been exhibited in the concentration of magnetic iron ores by means of magnetic separators. That the process is not novel is evident from the numerous patents (some of them half a century old) which have been issued for magnetic separators and from the record of operations with these appliances. The revival of interest in the concentration of lean magnetic iron ores is fortunately at a time when improvements in machinery for reducing in size and handling large quantities of material are supplemented by advanced knowledge of electro-magnetic appliances. The extent to which the process can be applied commercially to many ores can be decided only after a thorough investigation embracing the chemical and physical characteristics of the ore, the quantity accessible, the facilities for obtaining it, and the available market for the concentrated ore.

This method of beneficiating iron ores is confined to magnetite and such ores as can be made sufficiently magnetic to permit of their concentration by the appliances mentioned. No effort on a commercial scale has been made to treat any but ores which are naturally strongly magnetic, and most of the work done has been in enriching lean magnetite, although some ores carrying high percentages of iron have been fed to magnetic separators for the purpose of reducing the amount of phosphorus and sulphur. The predominance of magnetic iron ore in New York and New Jersey and the existence of large deposits of this class of ore in Pennsylvania and North Carolina have naturally attracted to these States most of the development in concentrating plants.

There is no question that the amounts of sulphur, phosphorus, silica, and in some cases titanium existing in magnetites can be considerably reduced if the material is sized and passed through magnetic separators, the degree of perfection reached being influenced by such reduction in size as will actually permit the mechanical separation of the pure magnetite from the other ingredients. In some of the titaniferous iron ores this element is so combined as to be magnetic also, and similarly the sulphur in other ores is in such combination as to make it partially magnetic. It may be possible, with improved machinery and greater knowledge, to separate various materials from each other, which differ but slightly in magnetism, but present practice is confined to separating magnetic from non-magnetic material, and the results achieved depend largely upon the comminution of the material, the rapidity with which it is fed on the separator, and the perfection of the machine.

COMPOSITION OF IRON ORE FROM IRON MOUNTAIN, MISSOURI.

Prof. W. B. Potter, of the Washington University, St. Louis, has contributed a complete suite of analyses of ore taken from the Iron Mountain mine, Missouri, during the year 1889. These determinations aggregate a total of 338, and from them the following statements of maxima, minima, and averages of the phosphorus, iron, and silica in the ore have been prepared for each class of ore described in the list by Prof. Potter as having been mined from the Iron Mountain deposit. The statements are offered as of special interest in showing the variations of composition of ores in one deposit.

Composition of iron ore from Iron Mountain, Missouri.

Kind of ore.	No. of samples.	Iron.			Phosphorus.			Silica.		
		Range.		Average.	Range.		Average.	Range.		Average.
Surface:		*Per cent.*		*Per ct.*	*Per cent.*		*Per ct.*	*Per cent.*		*Per ct.*
Lump	3	67.31 to	67.76	67.51	0.026 to	0.040	0.031	2.84 to	2.94	2.69
Jigged	13	63.14	65.30	64.21	0.013	0.044	0.033	4.21	5.79	5.16
Number 1 bluff:										
From Southern mine	37	62.78	67.15	65.59	0.034	0.209	0.113	2.82	7.91	4.41
From Shaft No. 11 (taken from dump)	14	58.98	63.40	61.46	0.006	0.064	0.023	5.73	9.50	7.47
Southeast mine	8	64.26	65.72	64.99	0.020	0.083	0.042	4.14	5.57	5.09
From dump	3	65.14	65.55	65.31	0.033	0.068	0.048	4.98	5.26	5.13
Select ore	2	67.16	67.47	67.31	0.015	0.020	0.017	2.58	2.95	2.76
Special ore (*a*)	20	62.76	64.82	63.74	0.010	0.055	0.018	4.80	7.12	5.96
Furnace jigged ore	48	59.17	64.80	61.91	0.025	0.208	0.105	4.23	10.54	6.90
Special from Little Mountain:										
Taken from mine (*b*)	4	63.39	64.63	63.81	0.013	0.018	0.016	4.83	6.69	5.45
Taken from dump	3	63.63	64.25	64.02	0.002	0.009	0.004	5.96	6.48	6.26
Soft lump ore:										
From incline No. 1—										
Taken from dump	8	60.50	62.71	61.87	0.072	0.191	0.124	5.90	9.45	7.60
From incline No. 2	7	65.17	65.91	65.52	0.052	0.114	0.085	1.99	3.64	2.61
Taken from dump	10	64.06	66.04	64.98	0.044	0.125	0.075	2.32	3.78	2.90
From shaft No. 1 (*c*)	54	64.31	66.57	65.46	0.011	0.047	0.025	2.66	5.02	3.69
Soft jigged ore:										
From incline No. 1—										
Taken from dump	12	60.88	63.47	61.92	0.054	0.093	0.077	4.98	7.68	5.86
From incline No. 2	22	62.23	64.70	63.31	0.044	0.148	0.065	3.76	5.63	4.78
Taken from dump	17	60.87	64.23	62.71	0.023	0.104	0.057	4.06	6.23	5.08
From separator No. 5 (*d*)	52	55.82	63.99	61.37	0.019	0.065	0.040	4.27	13.59	6.62

a One analysis of this ore showed 0.117 per cent. of manganese and another 1.02 per cent. of lime.

b This ore showed from 0.261 per cent. to 0.320 per cent. of manganese, with an average of 0.282 per cent.

c Two analyses of this ore show lime from 0.571 per cent. to 0.628 per cent., with an average of 0.599 per cent.; one shows sulphur 0.012 per cent.; one manganese 0.206 per cent.; and one 3.04 per cent. of alumina.

d Three samples of this ore show lime ranging from 0.685 per cent. to 0.838 per cent., with an average of 0.743 per cent.; two samples of this ore show alumina ranging from 3.03 per cent. to 3.11 per cent., with an average of 3.07 per cent.; one sample showed 0.023 per cent. of sulphur.

GOLD AND SILVER.

By William Kent.

Early in the year 1890 the annual report of the Director of the Mint was published on the production of the precious metals in the United States during the calendar year 1889, in which he gave, according to the usual custom in these annual reports, his estimates of the production of gold and silver in the several States and Territories. These estimates are based upon the figures reported to the Director by private refineries, upon deposits of refined and unrefined metal at the several mints and assay offices, upon returns from the custom-houses of the precious metals exported and imported, and to some extent upon the estimates made by mint officers and agents in the several producing States and Territories.

A direct investigation of the product of the gold and silver mines in 1889 was made in 1890 for the Eleventh Census of the United States by Mr. R. P. Rothwell, special agent of the Census Office, in charge of the statistics of gold and silver mines, with whom the writer was associated as principal assistant. The work was begun in the latter part of 1889 by obtaining from all available sources a directory of producing mines, and early in 1890 the collection of schedule statistics was undertaken, both by the use of the mails and by the efforts of numerous special agents in the field, several of whom were also agents of the mint.

The methods of collection and of compilation adopted by the Census Office are given in detail in the report of the special agent and need not be described here, but it is sufficient to say that the results reached are unquestionably more accurate, as might have been expected from the facilities availed of, than the figures of any previous census or mint report. The difference between the mint and census figures is but trifling in the case of gold, but it is considerable in the case of silver, both as regards the total product and as regards the distribution among the States and Territories. Thus the total product of silver according to the mint (United States coining value) was $64,646,000 and according to the census $66,396,988. The product of Colorado according to the mint was $20,686,868 and according to the census $23,757,751, a difference of over $3,000,000. For the reasons above given the figures of the census are adopted here for the production of gold and silver in 1889. For the year 1890 the Annual Report of the Director of the Mint on the Production of the Precious Metals in the United States, published early in 1891, is taken as authoritative.

The following table shows the production of gold and silver in the years 1889 and 1890 by States. The production of silver is given both in ounces and in dollars, United States coining value $1.2929 per ounce.

Production of gold and silver in the United States in 1889 and 1890.

States.	Gold.		Silver.			
	Eleventh Census.	U. S. Mint.	Fine ounces.		United States coining value.	
	1889.	1890.	1889.	1890.	1889.	1890.
Alabama	$2,539	....	77	....	$100	....
Alaska	904,650	$762,500	9,219	7,500	11,918	$9,697
Arizona	910,174	1,000,000	1,812,961	1,000,000	2,343,977	1,292,929
California	12,586,722	12,500,000	1,062,578	900,000	1,373,807	1,163,636
Colorado	3,883,859	4,150,000	18,375,551	18,800,000	23,757,751	24,307,070
Georgia	107,605	100,000	359	400	464	517
Idaho	1,984,159	1,850,000	3,137,508	3,700,000	4,056,482	4,783,838
Maryland	10,369	....	....	....	....	....
Michigan	87,040	90,000	14,607	55,000	18,885	71,111
Montana	3,139,327	3,300,000	13,511,455	15,750,000	17,468,960	20,363,636
Nevada	3,506,295	2,800,000	4,696,605	4,450,000	6,072,241	5,753,535
New Mexico	815,655	850,000	1,251,124	1,300,000	1,617,578	1,680,808
North Carolina	146.795	118,500	3,000	6,000	3,879	7,757
Oregon	964,309	1,100,000	17,851	75,000	23,382	96,969
South Carolina	46,853	100,000	179	400	232	517
South Dakota	3,091,137	3,200,000	104,672	100,000	135,331	129,292
Texas	6,828	....	323,438	300,000	418,173	387,878
Utah	487,666	680,000	7,005,193	8,000,000	9,057,014	10,343,434
Virginia	4,100	....	10	....	13	....
Washington	186,150	204,000	28,464	70,000	36,801	90,505
Wyoming	14,512	....	....	....	....	....
Other States	....	40,000	....	2,000	....	2,585
Total	32,886,744	32,845,000	51,354,851	54,516,300	66,396,988	70,485,714

The number of mines from which statistics were obtained by the census and reported either as producing in 1889 or as doing development work, but not producing, or as temporarily stopped, but likely to produce in the near future, was 6,004. Besides this there were some thousands of small diggings, placers, washings, gulches, claims, locations, etc., which could not be classed as mines. The relative importance of the 6,004 mines is shown in the following table:

Relative importance of producing mines.

	Number.
Mines reported producing less than $1,000 bullion	1,610
From $1,000 to $10,000	1,408
From $10,000 to $50,000	437
From $50,000 to $100,000	95
From $100,000 to $250,000	107
From $250,000 to $500,000	44
Over $500,000	28
Total	3,729
Mines reported working, but not producing bullion	1,009
Mines reported idle	1,266
Total number of mines reported	6,004

The average earnings of all persons employed at the gold and silver mines from which returns were received or estimates made (57,635) was $725 a year, while the average output per man amounted to $1,723 a year.

The average daily rate of wages paid was as follows:

Rates of wages paid employés per day in gold and silver mines in 1889.

	Above ground.	Below ground.
Foremen	$4.21	$4.21
Mechanics	3.57	
Miners		3.13
Laborers	2.65	2.47

The production of gold in California continues to show a decrease. The production in 1870, according to the estimates of the Director of the Mint, was $25,000,000 and in 1877 only $15,000,000. It increased in the next four years to $18,200,000 in 1881, and then decreased somewhat irregularly to $12,586,722 in 1889, according to the census returns, and to $12,500,000 in 1890, as estimated by the Director of the Mint. The prohibition of hydraulic mining in California is the chief cause of the decrease in recent years. California still, however, produces more than three times as much gold as any other State and about two-fifths of the total production of the country. The four other leading gold-producing States, Colorado, Nevada, South Dakota, and Montana, have remained in approximately the same relative positions during the past ten years, each producing between $3,000,000 and $4,000,000 in the census year. Idaho comes next in the order of producing States, with nearly $2,000,000 in the census year. No other State produced in that year as much as $1,000,000.

As to silver, remarkable variations in the production of the several States have taken place in the past ten years. Nevada, which in 1878, according to the Director of the Mint, produced over $28,000,000 worth of silver, now produces less than $6,000,000 (United States coining value), while Montana, which produced $2,500,000 in 1880, produced over $17,000,000 in 1889, according to the census, and over $20,000,000 in 1890, according to the mint report. Colorado, whose production increased from $4,500,000 in 1877 to $17,000,000 in 1880, has still further increased its production to $23,757,751 in the census year, and over $24,000,000 in 1890, thus retaining the first place in silver production, which it has held since 1880. Utah has about doubled its production since 1880 reaching $9,000,000 in 1889, according to the census, and over $10,000,000 in 1890, according to the mint report. Idaho is fifth in the list of silver States, having increased in production from $450,000 in 1880 to $4,783,000 in 1890. Arizona appears to be rapidly decreasing in importance as a silver-producing State, its product being reported in 1882 as $7,500,000 (which, however, is probably a gross exaggeration), and only $2,343,977 in 1889 by the census, and $1,292,929 in 1890 by the Director of the Mint. New Mexico also is declining in importance, the product decreasing from $3,000,000 in 1885 to $1,680,000 in 1890. California also has decreased from $3,000,000 in 1884 to $1,373,807 in 1889, and to $1,163,636 in 1890. The silver product of other States than those mentioned is comparatively insignificant.

The following table shows the latest estimates of the product of gold and silver in the United States since 1792:

Product of gold and silver in the United States from 1792.

[The estimate for 1792–1873 is by Dr. R. W. Raymond, United States Mining Commissioner, and since by the Director of the Mint.]

Years.	Total.	Gold.	Silver.
April 2, 1792–July 31, 1834	$14,000,000	$14,000,000	(*a*)
July 31, 1834–Dec. 31, 1844	7,750,000	7,500,000	$250,000
1845	1,058,327	1,008,327	50.000
1846	1,189,357	1,139,357	50,000
1847	939,085	889,085	50,000
1848	10,050,000	10,000,000	50,000
1849	40,050,000	40,000,000	50,000
1850	50,050,000	50,000,000	50,000
1851	55,050,000	55,000,000	50,000
1852	60,050,000	60,000,000	50,000
1853	65,050,000	65,000,000	50,000
1854	60,050,000	60,000,000	50,000
1855	55,050,000	55,000,000	50,000
1856	55,050,000	55,000,000	50,000
1857	55,050,000	55,000,000	50,000
1858	50,500,000	50,000,000	500,000
1859	50,100,000	50,000,000	100,000
1860	46,150,000	46,000,000	150,000
1861	45,000,000	43,000,000	2,000,000
1862	43,700,000	39,200,000	4,500,000
1863	48.500,000	40,000,000	8,500,000
1864	57,100,000	46,100,000	11,000,000
1865	64,475,000	53,225,000	11,250,000
1866	63,500,000	53,500,000	10,000,000
1867	65,225,000	51,725,000	13,500,000
1868	60,000,000	48,000,000	12,000,000
1869	61,500,000	49,500,000	12,000,000
1870	66.000,000	50,000.000	16,000,000
1871	66.500,000	43,500,000	23,000,000
1872	64,750,000	36,000,000	28,750,000
1873	71,750,000	36,000,000	35,750,000
1874	70,800,000	33,500,000	37,300,000
1875	65,100,000	33,400,000	31,700,000
1876	78,700,000	39,900,000	38,800,000
1877	86,700,000	46,900,000	39,800,000
1878	96,400,000	51,200,000	45,200,000
1879	79,700,000	38,900,000	40,800,000
1880	75,200,000	36,000,000	39,200,000
1881	77,700,000	34,700,000	43,000,000
1882	79,300,000	32,500,000	46,800,000
1883	76,200,000	30,000,000	46,200,000
1884	79,600,000	30,800,000	48,800,000
1885	83,400,000	31,800,000	51,600,000
1886	86,000,000	35,000,000	51,000,000
1887	86,350,000	33,000,000	53,350,000
1888	92,370,000	35,175,000	59,195,000
1889 { mint	97,446,000	32,800,000	64,646,000
1889 { census	99,282,866	32.886,180	66,396,686
1890	103,330,714	32,845,000	70,485,714
Total (*b*)	2,869,483,483	1,871,706,769	997,776,714

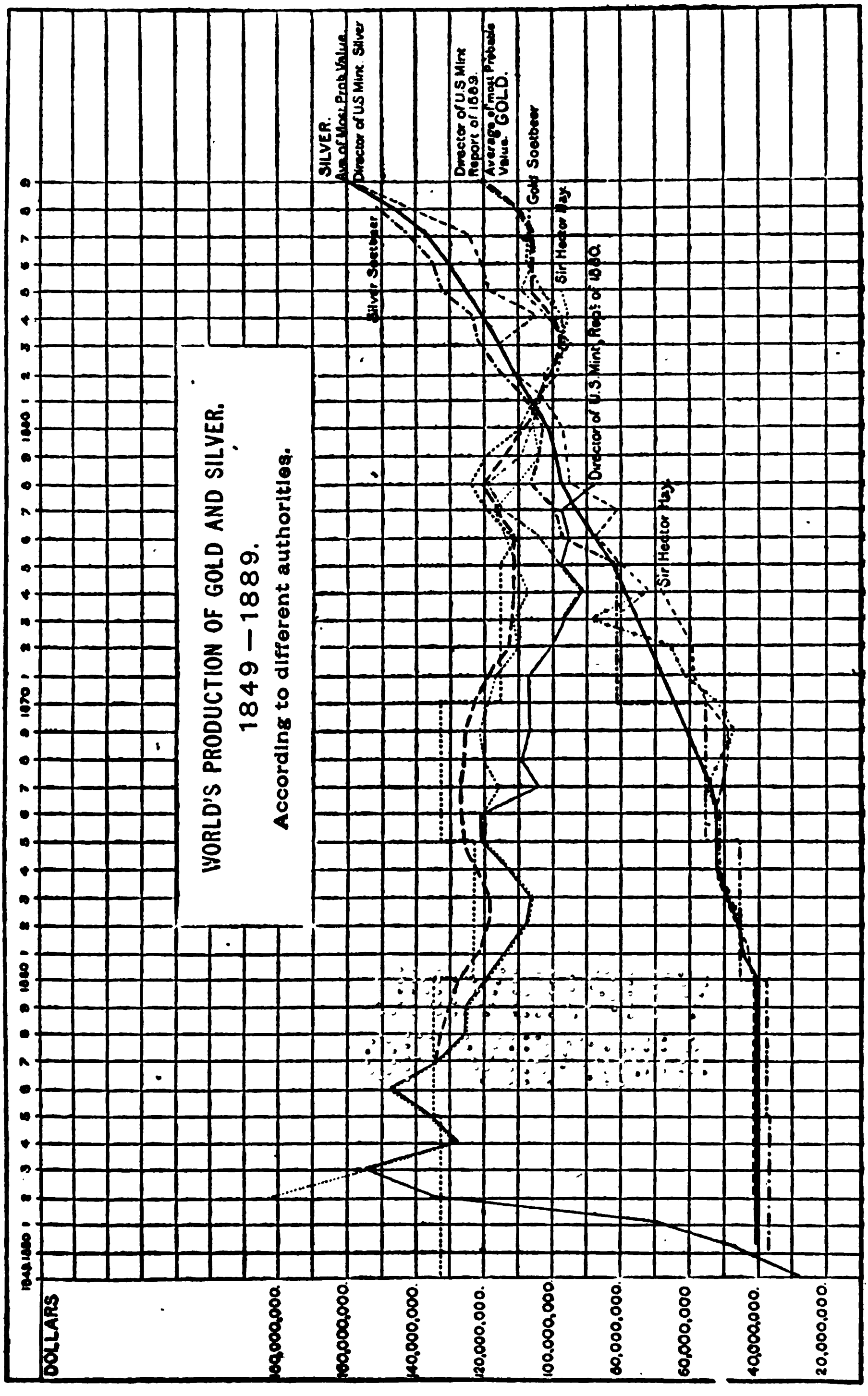
a Insignificant.

b In the total the mint figures, and not the census, are included.

WORLD'S PRODUCTION OF GOLD AND SILVER.

The writer, in the course of his work on the Eleventh Census of gold and silver for the calendar year 1889, made a study of the various published statistics of the gold and silver production of the world from 1850 to 1889. The results of this study are published at length in the census report. A comparison of the various published figures showed that there is a probability that the best tables hitherto published are far from being accurate, and it is a matter of considerable difficulty to decide which of two conflicting sets of figures for any one year have the greater probability of an approach to accuracy. Dr. Soetbeer, the eminent German authority on statistics of the precious metals, writes as follows on this question:

"The longer and more zealously a conscientious investigator busies himself with the statistics of the production and employment of the precious metals, the more will he be convinced that, with some exceptions, the numerical results obtainable relating to such production and employment are of a very uncertain nature; that they possess only the character of a greater or less approach to the reality, and of greater or less probability that the round numbers laid before the student deserve confidence, because apparently most carefully calculated on positive data, and that a continual revision of the estimates seems desirable."



WORLD'S PRODUCTION OF GOLD AND SILVER.
1849—1889.
According to different authorities.

By taking the figures of the several authorities and plotting them in the form of a diagram, and studying with particular care those portions where the authorities showed a wide divergence in their figures, a curve of "most probable values" of production of gold and silver was obtained, from which the figures given in the following table were taken.

The bottom line in the table below is not in the census report, but is added from the figures given in the report of the Director of the Mint.

Most probable values of the world's production of gold and silver—price of silver, and ratio of gold to silver.

Years.	Production. (*a*) (Value in millions of dollars.)			Percentage of total.		Price of silver in London. (Pence per ounce standard.)	Value of silver per fine ounce.	Price ratio 1 ounce gold. (Ounces silver.)
	Total gold and silver.	United States coining value.						
		Gold.	Silver.	Gold.	Silver.			
1850 to 1855	172	132	40	76.7	23.3	61¼	$1.337	15.42
1856	174	134	40	77.0	23.0	61 5/16	1.344	15.34
1857	174	134	40	77.0	23.0	61¾	1.353	15.27
1858	173	133	40	76.9	23.1	61 5/16	1.344	15.36
1859	170	130	40	76.5	23.5	62 1/16	1.360	15.21
1860	167	127	40	76.0	24.0	61 11/16	1.352	15.30
1861	167	122	45	73.1	26.9	60 13/16	1.333	15.48
1862	165	119	46	72.1	27.9	61 7/16	1.346	15.36
1863	168	119	49	70.8	29.2	61⅜	1.345	15.38
1864	174	122	52	70.1	29.9	61⅜	1.345	15.39
1865	178	126	52	70.8	29.2	61 1/16	1.338	15.43
1866	179	127	52	70.9	29.1	61⅛	1.339	15.44
1867	181	127	54	70.2	29.8	60 9/16	1.328	15.57
1868	183	126	57	68.9	31.1	60½	1.326	15.61
1869	186	125	61	67.2	32.8	60 7/16	1.325	15.60
1870	187	123	64	65.8	34.2	60 9/16	1.328	15.60
1871	187	119	68	63.6	36.4	60½	1.326	15.58
1872	184	113	71	61.4	38.6	60 5/16	1.322	15.64
1873	187	112	75	59.9	40.1	59¼	1.298	15.93
1874	190	111	79	58.4	41.6	58 5/16	1.278	16.16
1875	193	111	82	57.5	42.5	56⅞	1.246	16.63
1876	199	111	88	55.8	44.2	52¾	1.156	17.80
1877	209	116	93	55.5	44.5	54 13/16	1.201	17.19
1878	217	120	97	55.3	44.7	52 9/16	1.152	17.96
1879	213	114	99	53.5	46.5	51¼	1.123	18.39
1880	209	108	101	51.7	48.3	52¼	1.145	18.06
1881	210	104	106	49.5	50.5	51 11/16	1.138	18.24
1882	211	100	111	47.4	52.6	51⅝	1.136	18.27
1883	212	97	115	45.8	54.2	50⅝	1.110	18.65
1884	220	100	120	45.5	54.5	50¾	1.113	18.63
1885	231	106	125	45.9	54.1	48 9/16	1.065	19.39
1886	236	106	130	44.0	55.1	45⅜	0.995	20.78
1887	242	106	136	43.8	56.2	44⅝	0.978	21.13
1888	256	110	146	43.0	57.0	42⅞	0.939	21.99
1889	279	120	159	43.0	57.0	42 11/16	0.935	22.09
1890	289	118	171	40.8	59.2	47¾	1.053	....

a The figures of production are the "most probable values" arrived at from a comparison of the tables of Soetbeer, the Director of the Mint, and Sir Hector Hay. The price of silver is taken from the report of the Director of the Mint for 1889. The price ratio is from Soetbeer's tables down to 1885, and from 1886 to 1889 is calculated from the London price.

A study of the preceding table of the world's annual production of gold and silver, and the price of silver from 1850 to 1889, shows that the world's gold production from 1850 to 1857 remained nearly constant at about $134,000,000; then decreased irregularly till 1883, reaching a minimum of $97,000,000; then increased irregularly to 1889, when the product was $120,000,000. The silver production remained nearly constant from 1850 to 1860 at above $40,000,000, increasing slowly to 1866 to $52,000,000; then increased steadily and rapidly to 1887, and still more rapidly in 1888 and 1889 to $159,000,000.

The ratio of total value of silver product (at United States coining value) to that of the total of both gold and silver remained nearly constant, about 24 per cent, until 1860, increasing irregularly to 30 per cent in 1867, then steadily to 57 per cent in 1889, becoming equal to gold, or 50 per cent, in 1881. Thus both the production of silver and the ratio of silver production to total of silver and gold had a period of slow increase from 1860 to 1867, and then a rapid increase, beginning in 1867 and lasting to the present time. The price of silver remained nearly constant (at over 60 pence per ounce standard in London, equal to over $1.32 per ounce fine) until 1872, being unaffected either by the decrease in the gold production or by the increase in silver production. In 1872 the rapid decrease in gold production, which had taken place for four years previously was arrested, and for the next four years the decrease was very slight, and in the ten years following a considerable increase took place. At this time (1872) no change took place in the rate of increase of silver production, this rate being nearly the same from 1867 to 1877; yet in 1873 began the decrease in price of silver, which has continued with but slight fluctuations to the present time. During the twenty-three years (1850 to 1872) the whole extent of the variation in price was only between $1.36 and $1.32 per ounce, or 3.8 cents, while in the seventeen years, 1872 to 1889, inclusive, it declined from $1.322 to $0.935, or 38.7 cents, or over 26 per cent.

The table does not reveal the cause of the decline in the price of silver, for if it be assumed that the ratio of the production of silver to that of gold controls the price of the former, then the decrease in the price should have begun in 1860, when the ratio of silver product began to increase, and the decrease would have been more pronounced in 1867, when the silver product increased more rapidly and the gold production decreased. There is nothing in the figures or in the diagram to explain why the decline began in 1873 instead of in 1860 or 1867. A study of Soetbeer's figures for 380 years, from 1493 to 1873, will also show no relation between the relative production of gold and silver, and from 1800 to 1870, although the value of the product of the two metals varied from 3.227 silver to 1 of gold down to 0.44 silver to 1 of gold, the relative price varied only between 15.41 and 15.83 to 1. From the year 1873 to the present time, however, there appears to be a very close agreement between the product ratio and the price ratio, as shown by the coincidence between the columns in the table representing "gold production, per cent of total gold and silver," and price of silver in pence in London. Thus, in 1873 the total value of the gold product, expressed as a percentage of the total of the gold and silver, was 59.9 per cent, and in 1889 it was 43 per cent; the price of silver in London in 1873 was 59¼ pence, and in 1889, 42$\frac{11}{16}$ pence.

COPPER.

By C. Kirchhoff.

The distrust and doubt following the collapse of the French syndicate in 1889 brought about a rapid and continuous decline until 10½ cents a pound was touched for lake copper. It became evident, however, that consumers who had been starving themselves during the period of artificially high prices were liberal purchasers, and that the stock in the bankers' control was being handled cautiously and judiciously. Probably the most striking source of purchases of copper was that for electrical purposes, the development of electric lighting and traction having been phenomenal on both sides of the Atlantic. The metal began to recover in the fall of 1889, and maintained a level which made the year 1890 a profitable one. Considering the severe strain upon it during the progress and the collapse of the French syndicate, the American copper industry has developed well. During the two years under review no discoveries have been made of such magnitude as to influence the supply materially, nor has there been any permanent curtailment of product through the exhaustion of deposits which have been actively worked for some time past.

The publication of the report of the census, which covers the calendar year 1889, furnishes some interesting data, which may be referred to, since efforts have been made to deliberately misrepresent the figures and their teachings. The returns show that the cost of mining ore, which finally yielded 220,569,438 pounds fine, was $12,062,180, or 5.47 cents per pound, the cost being $3.63 per ton of copper ore. The following table deals with the mining cost in the three principal districts:

Mining cost of copper.

States.	Yield fine copper.	Cost per pound copper.	Cost per ton of ore.	Labor cost per pound copper.(*a*)
	Per cent.	*Cents.*		*Cents.*
Michigan	1.797	8.55	$3.07	3.63
Montana	7.002	3.27	4.59	2.05
Arizona	10.079	3.66	7.87	2.32

a Exclusive of amounts paid office force and contractors.

This table seems to indicate a high cost of production on the part of the Lake Superior mines, but it must not be forgotten that the outlays for the separation of the copper vary very widely in the different regions. In Michigan cheap crushing and washing leads at once to a high-grade product, yielding on the average 74.24 per cent. of ingot. The cost of crushing and washing during the census year averaged only 0.59 cent per pound. The cost of refining, of shipment to market, and of marketing is low. A guide to the magnitude of these expenditures is furnished by the annual report of a number of the companies. Mines whose total product was 42,977,065 pounds in the year 1889 gave expenditures aggregating $686,663.48 for smelting, freight, brokerage, insurance, and taxes, the rate being 1.60 cents per pound. These data indicate that the cost of copper, delivered and sold, including outlays for betterments in the majority of cases, was 10.74 cents per pound.

For the Montana mines the cost of mining the copper rock is only a small part of the cost of production. The census report shows that the cost of concentrating and smelting was 6.16 cents per pound, nearly 90 per cent. of the product being in the form of matte, while the balance is blister copper. This must be shipped either to American or to foreign refiners, the cost of treatment being very considerably higher. The census investigation did not deal with the question of the cost of shipment of matte, nor could the cost of refining it be arrived at, since the reports of the refiners embrace the cost of treating other material. There must therefore be added to the cost of the fine copper in the matte or blister, on cars at the Montana smelting works, which averages 9.43 cents, the cost of shipment and of refining. It is probable that this carried the total to at least 11 cents per pound, from which must be deducted the value of the silver in the case of those companies which mine argentiferous ores, and the profit on the precious metal in the case of those works which purchase silver ores in the open market. Considering the advantage which the lake mines have as sellers of a higher grade of copper, even over the Montana producers who market their metal as electrolytic, the balance still rests in favor of the Michigan companies.

The Arizona mines produce at relatively low cost. According to the census report, the cost of concentrating and smelting the ores was 4.01 cents, which would carry the cost of copper in the blister and matte, at furnace in Arizona, to 7.67 cents. To this, too, the cost of transportation to the refinery, the cost of refining, and of marketing must be added, and allowance be made for silver in the case of one company. The quality of product is good, so that the Arizona mines possess the ability to meet a 10-cent copper market without loss.

On the cost of refining, the census report covers establishments producing a total of 159,693,252 pounds of refined copper. The average was 1.18 cents per pound. The report, however, segregates one group of refiners which treat exclusively high grade material like lake mineral, Arizona bars, and Montana blister copper. On a total product of 105,400,664 pounds, the average cost was 0.68 cent per pound. By deduction it appears that the 54,292,588 pounds produced from other grades of raw material cost 2.15 cents per pound.

The refining facilities are being largely increased in this country. The Baltimore works have nearly completed a new plant, the Calumet & Hecla Company is building works at Black Rock, New York, the Kansas City Smelting and Refining Company has started a new plant, and the Omaha & Grant Smelting and Refining Company has begun a copper refinery. In Colorado the Pueblo Smelting and Refining Company and the St. Helen's Smelting Company are handling cupriferous material. It is probable, therefore, that soon the American refiners will be in a position to handle all the copper produced in this country, so that our exports will consist more and more of ingot and less of matte.

DOMESTIC PRODUCTION.

The following table, showing the growth in the production of copper in the United States, is compiled, as far as the years previous to 1882 are concerned, from the best data available. Since that year the statistics are those collected by this office, with the exception of the year 1889, when the figures were gathered by the Census Office. It should be stated that the yield of copper from pyrites is not here included.

Product of copper in the United States from 1845 to 1890, inclusive.

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Long tons.	*Long tons.*	*Long tons.*	
1845...	100	12	....	12.0
1846...	150	26	....	17.3
1847...	300	213	....	71.0
1848...	500	461	....	92.2
1849...	700	672	....	96.0
1850...	650	572	....	88.0
1851...	900	779	....	86.6
1852...	1,100	792	....	72.0
1853...	2,000	1,297	....	64.9
1854...	2,250	1.819	....	80.8
1855...	3,000	2,593	....	86.4
1856...	4,000	3,666	....	91.7
1857...	4,800	4,255	....	88.6
1858...	5,500	4,088	....	74.3
1859...	6,300	3,985	....	63.3
1860...	7,200	5,388	....	74.8
1861...	7,500	6,713	....	89.5
1862...	9,000	6,065	....	67.4
1863...	8,500	5,797	....	68.2
1864...	8.000	5,576	....	69.7
1865...	8,500	6,410	....	75.4
1866...	8.900	6,138	....	69.0
1867...	10,000	7,824	603	78.2
1868...	11,600	9,346	2,276	80.6
1869...	12,500	11,886	5,497	95.1
1870...	12,600	10,992	6,277	87.2
1871...	13,000	11,942	7,242	91.9
1872...	12,500	10,961	7,215	87.7
1873...	15,500	13,433	8,414	86.7
1874...	17,500	15,327	8,984	87.6
1875...	18,000	16,089	9,586	89.4
1876...	19,000	17,085	9,683	89.9
1877...	21,000	17,422	10,075	83.0
1878...	21,500	17,719	11,272	82.4
1879...	23,000	19.129	11,728	83.2
1880...	27,000	22,204	14,140	82.2
1881...	32,000	24,363	14,000	76.1
1882...	40,467	25,439	14,309	62.9
1883...	51,574	26,653	14,788	51.6
1884...	64,708	30,961	18,069	47.8
1885...	74,052	32,209	21,093	43.5
1886...	70,430	36,124	22,553	51.3
1887...	81,017	33,941	20.543	41.9
1888...	101,054	38,604	22,453	38.2
1889...	100,918	39,048	21,727	38.7
1890...	115,669	44,976	26,727	38.9

It is a striking fact that the Lake Superior district in 1890 made more copper than was produced in the whole country in 1882. The returns for 1890 reflect the influence of good prices, but it may be stated in a general way that the output has now reached figures which are not likely to be much exceeded in the near future. While a number of the large mines are making preparations for working on a larger scale, others will find increasing difficulties in maintaining their best rate of output. There have been no discoveries which give promise of suddenly flooding the markets, the only new district of promise being the "Seven Devils" district in Idaho. A noteworthy feature is the opening out of cupriferous bodies in the lower levels of some of the Leadville mines.

The following is, in detail, the output of the Lake Superior mines, as reported by the companies:

Product of Lake Superior copper mines, 1884 to 1890.

Mines.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Calumet and Hecla	40,473,585	47,247,990	50,518,222	46,016,123	50,295,720	48,668,296	59,868,106
Quincy	5,650,436	5,848,530	5,888,517	5,603,691	6,367,809	6,405,686	8,064,253
Osceola	4,247,630	1,945,208	3,560,786	3,574,972	4,134,320	4,534,127	5,294,792
Franklin	3,748,652	4,007,105	4,264,297	3,915,838	3,655,751	4,346,062	5,638,112
Allouez	1,928,174	2,170,476	1,725,463	885,010	314,198	1,762,816	1,407,828
Atlantic	3,163,585	3,582,633	3,503,670	3,641,865	3,974,972	3,698,837	3,619,972
Pewabic	227,834						
Central	1,446,747	2,157,408	2,512,886	2,199,133	1,817,023	1,270,592	1,413,391
Grand Portage	255,860						
Conglomerate	1,198,691						
Mass	481,396	363,500	247,179			58,349	62,187
Copper Falls	891,168	1,150,538	1,378,679	719,150	1,199,950	720,000	665,000
Phœnix	631,004	344,355	1,101,804	11.000			
Hancock	562,636	203,037	150,000				
Huron	1,927,660	2,271,163	1,992,695	1,881,760	2,370,857	2,219,473	1,736,777
Ridge	74,030	63,390	158,272	84,902	50,924	28,000	21,569
Saint Clair	139,407						
Cliff	28,225		22,342				
Wolverine	751,763	328,610	3,125	2,300			
Nonesuch	23,867	28,484					
Isle Royale	16,074						
National	87,368	162,252	184,706	25,187		454,134	123,879
Minnesota	1,144	12,608					
Belt	130,851	27,433	7,300				
Sheldon and Columbia	9,828						
Adventure	4,333	4,000	1,000			692	15,485
Peninsula	1,225,981					736,507	1,108,660
Tamarack		181,669	3,646,517	7,396,529	11,411,325	10,605,451	10,106,741
Ogima	1,106	12,000					
Kearsarge				21,237	829,185	1,918,849	1,598,525
Evergreen Bluff	954	1,500	1,000			21,580	
Ash Bed	1,517						
Sundry companies—tributers	21,696	34,000	50,000	50,000	50,000	6,224	
Total	69,353,202	72,147,889	80,918,460	76,028,697	86,472,034	87,455,675	100,745,277

A somewhat different system has beeen adopted in the distribution of the product of the Western States outside of Montana, Arizona, and New Mexico, in which there is little copper mining proper, but in which considerable metal is raised as an incidental constituent of gold, silver and lead ores. This metal comes to lead and copper smelters often in small parcels, the source of which is not readily traced. In the above table the copper contents of matte produced by lead smelters has been credited to the States and Territories in which the works are located. The total quantity so distributed in 1890 was 1,906,913 pounds fine. The lead-refiners smelt large quantities of lead and dry ores containing copper and obtain some of the same metal from base bullion received. The product of Colorado copper smelters has been separately stated, deducting those quantities known to have come from other States and

Territories. This is notably the case with the product of a Montana works which goes to a Colorado establishment, which is often erroneously added to the product of that State, thus duplicating the amount. The Colorado copper smelters also treat large quantities of the matte made by Colorado lead works, thus again leading to duplication and causing an undue swelling of alleged Colorado output. It is probable, however, that by far the larger part of the quantity of copper enumerated under "copper-smelters" did originate in that State.

Total copper production in the United States, 1883 to 1890, inclusive.

Sources.	1883.	1884.	1885.	1886.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	59, 702, 404	69, 353, 202	72, 147, 889	80, 918, 460
Arizona	23, 874, 963	26, 784, 345	22, 706, 366	15, 657, 035
Montana	24, 664, 346	43, 093, 054	67, 797, 864	57, 611, 621
New Mexico	823, 511	59, 450	79, 839	558, 385
California	1, 600, 862	876, 166	469, 028	430, 210
Utah	341, 885	265, 526	126, 199	500, 000
Colorado	1, 152, 652	2, 013, 125	1, 146, 460	409, 306
Wyoming	962, 468	....	....	....
Nevada	288, 077	100, 000	8, 871	50, 000
Idaho	....	46, 667	40, 381	....
Missouri	260, 306	230, 000	....	....
Maine and New Hampshire	212, 124	249, 018	211, 602	315, 719
Vermont	400, 000	655, 405		
Southern States	395, 175	317, 711	40, 199	29, 811
Middle States	64, 400	2, 114	190, 641	....
Lead-desilverizers, etc	782, 880	950, 870	910, 144	1, 282, 496
Copper-smelters (*a*)	....	....	....	....
Total domestic copper	115, 526, 053	144, 946, 653	165, 875, 483	157, 763, 043
From imported pyrites and ores	1, 625, 742	2, 858, 754	5, 086, 841	4, 500, 000
Total (including copper from imported pyrites)	117, 151, 795	147, 805, 407	170, 962, 324	162, 263, 043

Sources.	1887.	1888.	1889.	1890.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	76, 028, 697	86, 472, 034	87, 455, 675	100, 745, 277
Arizona	17, 720, 462	31, 797, 300	31, 586, 185	34, 796, 689
Montana	78, 699, 677	97, 897, 968	98, 222, 444	112, 980, 896
New Mexico	283, 664	1, 631, 271	3, 686, 137	850, 034
California	1, 600, 000	1, 570, 021	151, 505	23, 347
Utah	2, 500, 000	2, 131, 047	65, 467	1, 006, 636
Colorado	2, 012, 027	1, 621, 100	1, 170, 053	883, 132
Wyoming	....	232, 819	100, 000	....
Nevada	....	50, 000	26, 420	....
Idaho	....	50, 000	156, 490	87, 243
Missouri	....	....	....	....
Maine and New Hampshire	200, 000	271, 631	72, 000	378, 840
Vermont				
Southern States	....	18, 201	18, 144	
Middle States	....	....	....	
Lead-desilverizers, etc	2, 432, 804	2, 618, 074	3, 345, 442	4, 643, 439
Copper-smelters (*a*)	....	....	....	2, 702, 559
Total domestic copper	181, 477, 331	226, 361, 466	226, 055, 962	259, 098, 092
From imported pyrites and ores	3, 750, 000	4, 909, 156	5, 190, 252	6, 017, 041
Total (including copper from imported pyrites)	185, 227, 331	231, 270, 622	231, 246, 214	265, 115, 133

a Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.

Lake Superior.—The Calumet and Hecla Company has progressed in the direction of a larger output and is still adding to its enormous equipment. The report of Mr. Alexander Agassiz, the president, for the fiscal year ending April 30, 1891, records the fact that the openings are again gaining on the stoping, and adds: "At our present rate of production (30,000 tons of refined copper per annum) we must have from sixteen to seventeen years of ground opened."

Tamarack.—During its fiscal year ending June 30, 1891, the product of the Tamarack had risen to 14,076,957 pounds from 18,776,153 pounds of mineral, obtained from crushing 282,987 tons of rock, showing a percentage in stamp rock of 2.49 per cent of refined copper. The underground expense was $522,834.07, and the outlays for stamping, transportation, etc., $205,281.81; for smelting and marketing the copper the cost was $213,921.24, making the total mining cost $942,037.12. The sale of copper and interest receipts realized $2,008,776.92, thus showing a mining profit of $1,066,739.80, out of which dividends aggregating $750,000 were paid. The balance of $316,739.80 nearly paid for the construction account of $340,430.71. This included $182,253.31 expended in the equipment of mine and mill, including a large air-compressor, and leaves the future construction work of small proportions. Sinking is, however, progressing on shafts Nos. 3 and 4, which are being driven to reach another part of the tract and must go to much greater depth. The running cost is figured at 5.17 cents per pound, to which must be added 1.52 cents for smelting, freight, and all expenses of handling copper, making a total of 6.69 cents. The construction cost figures 2.42 cents per pound of copper produced, so that including it a total of 9.11 cents is reached. There were originally paid in $13 per share, or $650,000, and subsequently 10,000 shares were sold at $100 per share, so that the capital investment, less $13 per share credited to capital stock, reached $1,520,000. The whole construction expense was $1,362,279.18, and, after paying dividends aggregating $2,070,000 and acquiring real estate of $200,000, there remained a balance of quick assets of $1,024,055.56. The total product of copper was 51,055,261 pounds, which realized $6,589,611.86, or an average of 12.91 cents.

Quincy.—The Quincy is increasing its stamping facilities by the addition of two ball stamps and the necessary pumping machinery, which will bring its monthly products up to 1,000 or 1,100 tons. During the year 1889 there were mined 167,077 tons of rock, of which 123,998 tons were hoisted and 117,875 tons were stamped with a yield of 2.82 per cent. of mineral, or 6,641,785 pounds. There was also produced 1,178,225 pounds of masses, the total yield of refined copper being 6,405,686 pounds. Owing to the low price of copper, the net earnings were only $182,601.14, and yet $200,000 was paid in dividends. In 1890, however, the increased product (from 187,244 tons mined and 165,145 tons stamped, producing 7,262,485 pounds of stamp mineral and 2,740,365 of masses), 8,064,253 pounds of ingots, together with the much higher price and lessened construction account, ran the net income up to $596,677.60, out of which dividends of $400,000 were paid. The company has paid

$5,770,000 in dividends on a total product of 114,691,387 pounds of copper, with an original capital of $200,000 paid in, and had assets, after paying the last dividend, of $542,045.15.

Franklin.—During 1889 and 1890 the Franklin showed a steady recovery in the grade of the rock, the copper contents of the material hoisted being 1.497 per cent. in 1890 against 1.164 per cent. in 1889, 1 per cent. in 1888, and 1.12 per cent. in 1887. The amount of rock hoisted rose from 186,740 tons in 1889 to 188,355 tons in 1890, while the quantity crushed increased from 141,579 tons to 144,393 tons, the yield of ingot copper rising from 4,346,062 pounds to 5,638,112 pounds. The cost per ton of rock hoisted rose from $1.84 in 1889 to $1.90 in 1890, which is, however, due to the fact that the stock of underground was largely increased. Owing to better prices, the net income jumped from $139,577.52 in 1889 to $373,612.49 in 1890.

Huron.—The Huron has continued a difficult struggle for existence, and experienced a heavy falling off in the product in 1890, which was only 1,736,777 pounds in that year against 2,219,473 pounds in 1889, and an assessment of $200,000 was levied in 1890. The rock is apparently too lean to allow of profitable work. The rock stamped yielded only 0.86 per cent. of ingot in 1890, against 0.98 per cent. in 1889, and yet the quantity mined but rejected as too poor was enormous. Thus in 1890 not less than 45,501 tons, or nearly 31 per cent. of the whole taken out of the mine, was rejected. It seems that the productive ground is rapidly pitching toward the south, so that the lode in the bottom levels in the northern part of the mine is absolutely barren. In 1890 the cost per ton of rock hoisted was $1.89 against $1.69 in 1889.

Atlantic.—For close work, on a narrow margin, the Atlantic continues to be the most interesting mine in the Lake Superior district. The details of costs for a series of years are given in the following table:

Cost of copper at the Atlantic mine per ton of rock treated.

Items of cost.	1885.	1886.	1887.	1888.	1889.	1890.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Mining, selecting, breaking, and all surface expenses, including taxes	78.62	80.88	87.23	83.73	87.87	104.14
Transportation to mill	4.80	3.48	3.80	3.47	3.88	3.46
Stamping and separating	30.36	26.53	27.31	26.89	27.78	27.78
Freight, smelting, marketing, and New York expenses	25.45	24.25	23.07	21,42	20.22	20.37
Total working expenses	139.23	135.14	141.41	135.51	139.75	155.75
Total expenditures	143.60	138.01	145.22	142.82	153.27	166.70
Net profit	22.05	15.29	30.53	54.36	6.23	27.71
Yield of copper, per cent	0.743	0.709	0.712	0.667	0.663	0.650

The figures for the year 1889 clearly show that, with copper at 12 cents, the closest economy will hardly permit of a profit. In that year, after paying $37,669.56 for construction, the net profit was $26,679.61, carrying the surplus up to $323,020.93, out of which a dividend of

$60,000 was paid. The better price realized in 1890 allowed a mining profit of $112,064.29 to be obtained, out of which $30,495.21 was paid for construction, and $80,000 was paid in dividends. The mine is renewing its hoisting plant and preparing for deeper work, a high-speed direct-acting engine having been placed in 1889 with great success. The question of depositing the stamp-mill sands has been dealt with.

Central.—In 1889 and 1890 the Central mine was troubled with an irregularity in the vein, in depth, which proved to be due to a throw of 220 feet westward. In 1889 the production was lessened by the necessity of straightening the main shaft, and this, coupled with the low price of copper, created an apparent loss of $26,575.59. The surplus was, however, drawn upon for a dividend of $20,000. The better returns for 1890 left a profit of $22,607.33, out of which a dividend of $20,000 was distributed, leaving the surplus at $109,993.88, exclusive of real estate or plant. The mine has paid a total of $1,970,000 on a capital of $100,000.

Allouez.—The Allouez Company has struggled with adversity. Low prices in 1889 caused a suspension of operations towards the end of October, and work was not resumed until May of the following year. In February, 1891, a fire destroyed the rock house. The company works a low-grade rock, the yield of refined copper per ton of rock mined having been only 0.67 per cent. in 1889 and 0.57 per cent. in 1890. In the former year the cost of the copper marketed, all expenses paid, was 12.80 cents, while in 1890 it was 14.65 cents. In 1889 the receipts, including an assessment of $40,000, were $253,177.76, and the outlays $238,791.55. In 1890 the stockholders were again called upon for $40,000, including which the receipts were $247,428.28, the expenditures reaching $257,830.40. Exploratory work for the Calumet and Hecla lode did not lead to favorable results.

Osceola.— In 1890 the Osceola had a prosperous year, since $225,000 was paid in dividends, carrying the total up to January 1, 1891, to $1,447,500 on a capital of $1,250,000. Increased wages and extraordinary expenditures brought the mining cost per ton of stamp rock to $2.39, against $2.21 in 1889. On the other hand, however, the quality of the rock handled improved, the average being 1.44 per cent. in 1890, as compared with 1.291 per cent. in 1889. In 1890, 214,467 tons of rock were hoisted, of which 183,825 tons were sent to the mill. The cost of the copper at the mine was 8.31 cents, to which must be added 1.51 cents for smelting, freight, and handling, bringing the total to 9.82 cents. There were, however, construction costs footing up to $75,156.19, which, added to the new cost, bring the total amount at which the metal was produced to 11.24 cents.

Kearsarge.—The Kearsarge mine continued during 1889 to draw upon its reserves in the upper levels without opening up much promising ground at greater depth. In 1890, however, the chances for developing a permanent mine were improved by better developments. Although a larger amount of rock was treated (73,541 and 74,368 tons hoisted in 1889 and 1890, and 56,104 tons and 60,619 tons respectively stamped), the product was smaller, falling from 1,918,849 pounds to 1,598,525 pounds of ingot, since the percentage of copper in stamp rock declined from 1.71 to 1.32 per cent. Although the cost per ton of rock fell from $2.49 to $2.26, the cost of copper at the mine rose from 7.27 cents in 1889 to 8.64 cents in 1890. Adding the cost of smelting, the totals are 9.21 and 10.47 cents, and including cost of construction, 9.52 and 10.68 cents for the two years. After paying a dividend of $80,000 on the 1st of January, 1890, the company closed the year with a balance of assets of $144,757.31. Explorations on the Calumet conglomerate did not lead to any valuable discoveries.

MONTANA.

During the years 1889 and 1890, the State maintained its high rate of copper production. Aside from the Butte and Boston Company, no new producers of any consequence entered the lists. The older concerns have added more or less to their equipment.

The annual reports of the Boston and Montana Company are of particular interest, since it is the only mine concerning whose operations data reached the public, thus affording some insight into the costs of mining and producing copper in the great Butte district.

During the fiscal year ending June 1, 1890, the production of matte and ore was 22,740 short tons, which yielded 26,003,604 pounds, from which $2,999,997.37 was realized, the corresponding figures for the fiscal year 1891 being 23,734 tons, with 26,693,842 pounds of copper, for which $2,937,134.18 was obtained. The average price, therefore, was 11 cents in 1890–'91, against 11.54 cents in 1889–'90, 11.60 cents in 1888–'89, and 11.52 cents in 1887–'88. It must be noted, however, that the relatively high price obtained is due to the fact that the company was still delivering on contracts with the French syndicate. In addition to the copper, the company produced in the fiscal year 1889–'90, 284,553 ounces of silver, and in 1890–'91, 255,856 ounces. The total running cost in 1889–'90 was $655,512.40 on 138,938 tons of ore, while in 1890–'91 it was $612,211.57 on 144,705 tons. The principal mines are the Mountain View, which produced 59,779 and 60,243 tons, respectively, in 1889–'90 and 1890–'91, at a cost of $3.31 and $3.57; while 32,013 and 25,341 tons of Pennsylvania ore cost $4.36 and $4.12, and 49,476 and 46,679 tons of Colusa ore, $4.76 and $5.51 per ton. These figures do not include construction costs, which in 1889–'90 figured up $106,046.94, and in 1890–'91, $87,347.69, the latter including $72,535.72 for the new Leonard shaft. The concentrating, calcining, and matte smelting cost $742,244.86 in 1889–'90, and $772,031.82 in 1890–'91, the other miscellaneous outlays for sacking, transportation, taxes, etc., being $138,645.31 and $139,588.75, respectively. Thus the total running expenses at the mine were $1,536,402.57 in 1889–'90, and $1,523,832.14 in 1890–'91, and adding construction cost at the mines and smelter, $1,663,638.07 and $1,628,666.05. This makes the cost of fine copper in matte and shipping ore at the mine respectively 6.40 and 6.10 cents. To this must be added, however, the heavy outlay for freight on matte to the refinery, copper charges, commissions, refining, etc., which in 1889–'90 amounted to $468,702.64, or 1.80 cents per pound, and in 1890–'91 to $577,481.45, or 2.16 cents per pound of fine copper contents, the whole thus reaching a total of 8.20 and 8.26 cents, respectively. It should be noted, however, that in this computation the copper is charged with the entire cost of production, thus leaving the silver to swell profits. The company has expended heavy sums for a new smelting plant at Great Falls, Montana, where water power is available, and an electrolytic refining plant is to be established ultimately. Prior to July 1, 1890, the outlays at Great Falls were $135,269.38. In the fiscal year 1890–'91 they were $462,980.79, thus making a total of $598,250.17, to which must be added the sums required for its completion early in 1892. The company has a capital stock of $3,125,000, in $25 shares; has issued $1,500,000 7 per cent bonds, of which $339,000 have been canceled, and has paid twelve dividends, aggregating $1,825,000, closing the year with a balance of quick assets of $621,715.60.

ARIZONA.

The history of the copper industry in Arizona has been uneventful during the past two years. Nearly the whole of the product came from the established mines, the Copper Queen and the Holbrook and Cave at Bisbee, the Arizona and the Detroit at Clifton, the Old Dominion at Globe, and the United Verde at Jerome.

COLORADO.

The most interesting development in this State has been the opening of large bodies of cupriferous ore in the lower levels of some of the Leadville mines. The Henriette and Maid has opened out a chute of ore 75 feet thick and from 100 to 150 feet wide of sulphide ore, with 40 to 60 ounces of silver, 5 to 8 per cent of copper, and about 5 per cent each of lead and of zinc.

IMPORTS.

The imports of fine copper contained in ores, and of regulus and black copper, and of ingot copper, old copper, plates not rolled, rolled plates, sheathing metal, and manufactures not otherwise specified, and of brass are given in the following tables:

Fine copper contained in ores, and regulus and black copper imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Fine copper contained in ores.		Regulus and black copper. (*a*)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1867	....	$936,271	....	....	$936,271
1868	3,496,994	197,203	....	....	197,208
1869	24,960,604	448,487	....	....	448,487
1870	1,936,875	134,736	....	....	134,736
1871	411,315	42,453	499	$60	42,513
1872	584,878	69,017	4,247	1,083	70,100
1873	702,086	80,132	1,444,239	279,631	359,763
1874	606,266	70,633	28,880	5,397	76,030
1875	1,337,104	161,903	12,518	2,076	163,979
1876	538,972	68,922	8,584	1,613	70,535
1877	76,637	9,756	1,874	260	10,016
1878	87,039	11,785	....	....	11,785
1879	51,959	6,199	....	....	6,199
1880	1,165,283	173,712	2,201,394	337,163	510,875
1881	1,077,217	124,477	402,640	51,633	176,110
1882	1,473,109	147,416	224,052	30,013	177,429
1883	1,115,386	113,349	....	....	113,349
1884	2,204,070	219,957	2,036	204	220,161
1885	3,665,739	343,793	285,322	20,807	364,600
1886	4,530,400	341,558	1,960	98	341,656
1887	3,886,192	194,785	27,650	1,366	196,151
1888	4,850,812	381,477	4,971	324	381,801
1889	3,772,838	274,649	60,525	4,244	278,893
1890	3,448,237	241,732	221,838	15,688	257,420

a Not enumerated until 1871.

Copper imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Bars, ingots, and pigs.		Old, fit only for remanufacture.		Old, taken from bottoms of American ships abroad. (*a*)		Plates not rolled.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	1,635,953	$287,831	569,732	$81,930	....	....	....	....
1868	61,394	6,935	818,705	42,652	....	....	....	....
1869	13,212	2,143	290,780	34,820	....	....	....	....
1870	5,157	418	255,386	31,931	....	....	....	....
1871	3,316	491	369,634	45,672	....	....	430	$129
1872	2,638,589	578,965	1,144,142	178,536	....	....	148,192	33,770
1873	9,697,608	1,984,122	1,413,040	255,711	32,307	$4,913	550,431	97,888
1874	718,935	134,326	733,326	137,087	9,500	930	....	....
1875	58,475	10,741	396,320	55,564	11,636	1,124	8	4
1876	5,281	788	239,987	35,545	10,304	1,981	5,467	600
1877	230	30	219,443	28,608	41,482	5,136	....	....
1878	1	1	198,749	25,585	....	6,004	....	....
1879	2,515	352	112,642	11,997	11,000	1,107	27,074	4,496
1880	1,242,103	206,121	695,255	91,234	....	....	120	11
1881	219,802	36,168	541,074	63,383	14,680	1,504	20	3
1882	6,200	836	508,901	59,629	16,075	1,629	....	....
1883	....	....	330,495	36,166	9,415	666	....	....
1884	(*b*)542	107	149,701	12,099	....	554	....	....
1885	914	172	81,312	6,658	....	1,160	....	....
1886	276	37	37,149	2,407	....	584	....	....
1887	212	22	39,957	2,374	....	129	....	....
1888	1,787	299	37,620	2,535	....	....	....	....
1889	3,160	522	19,912	1,176	....	....	....	....
1890	5,189	859	284,789	26,473	....	....	....	....

a Not enumerated until 1873. *b* Includes "plates not rolled" since 1884.

Copper imported and entered for consumption in the United States, 1867 to 1890—Cont'd.

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Plates rolled, sheets, pipes, etc.		Sheathing metal, in part copper. (*a*)		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867		$1,101	220,889	$37,717	$15,986	$424,565
1868		1	101,488	18,852	21,492	89,932
1869		39	43,669	6,592	43,212	86,806
1870		2,039			485,220	519,608
1871		7,487			668,894	722,673
1872		18,895			1,007,744	1,817,910
1873		4,514			869,281	3,216,429
1874		27	282,406	50,174	125,708	448,252
1875		617	136,055	26,650	35,572	127,272
1876		326	18,014	2,903	29,806	71,949
1877		208	110	22	41,762	75,761
1878		1,201	647	55	35,473	68,319
1879		786	300	20	39,277	58,035
1880		4,134	6,044	693	130,329	432,522
1881		82	39,520	4,669	284,509	390,318
1882	5,855	1,551			77,727	141,372
1883	2,842	379	6,791	1,047	40,343	78,601
1884	6,529	2,330	19,637	926	55,274	71,290
1885	470	120	86,619	9,894	61,023	79,027
1886	3,770	339	21,573	1,017	31,871	87,155
1887	37,925	5,493	18,189	1,867	37,289	47,174
1888	5,208	737	23,622	2,696	14,567	20,834
1889	13,848	2,082	23,520	2,572	13,430	19,782
1890	4,209	917	37,458	4,467	24,752	57,468

a Does not include copper sheathing in 1867, 1868, and 1869.

Brass imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Bars and pigs.		Old, fit only for remanufacture.		Not otherwise provided for.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867		$3,099		$26,468	$170,873	$200,440
1868	31,104	2,071	120,913	11,699	181,114	194,884
1869	33,179	2,457	131,640	10,838	198,310	211,605
1870	54,108	3,791	98,825	6,918	49,845	60,554
1871	28,453	2,803	438,085	37,922	13,659	54,384
1872	17,963	1,664	829,964	73,098	23,738	98,500
1873	56,656	7,147	699,478	71,494	114,767	193,408
1874	253	19	682,151	64,848	350,266	415,133
1875	370,273	38,867	124,285	12,786	273,873	325,526
1876			618,191	54,771	232,870	287,641
1877			689,633	59,402	207,642	267,044
1878			713,171	57,551	205,209	262,760
1879	950	49	485,354	32,278	232,080	264,357
1880			958,590	75,098	339,131	414,224
1881	85,370	11,202	1,615,402	151,541	331,506	494,249
1882	30,769	3,168	2,954,148	263,891	400,477	667,536
1883	6,380	559	1,015,345	84,786	485,321	570,666
1884	1,611	445	508,923	40,766	429,224	470,435
1885	2,305	532	166,317	15,717	400,175	416,424
1886	6,705	295	143,121	30,517	374,364	405,176
1887	2,332	562	189,157	30,158	331,800	362,520
1888			257,748	40,373	156,738	197,111
1889	7,667	1,093	188,467	37,293	140,193	178,579
1890	7,905	1,261	285,089	38,938	175,684	215,883

EXPORTS.

In a very brief time the United States, with its exuberant production, has become one of the largest contributors to the supply of the world. The following tables show the quantities of copper, copper ore (including matte), and manufactured copper exported for a series of fiscal years:

Value of copper, brass, and manufactured copper exported from the United States, 1791 to 1863, inclusive.

Fiscal years ending September 30 until 1842, and June 30 since.	Value.	Fiscal years ending September 30 until 1842, and June 30 since.	Value.
1791	$493	1833	$203, 880
1803	6, 233	1834	198, 273
1804	8, 654	1835	69, 791
1805	12, 977	1836	72, 991
1806	25, 340	1837	91, 724
1807	12, 742	1838	81, 363
1808	4, 031	1839	81, 334
1809	3, 095	1840	86, 954
1810	17, 426	1841	72, 932
1811	9, 282	1842	97, 021
1812	2, 644	1843 (nine months)	79, 234
1813	....	1844	91, 446
1814	....	1845	94, 736
1815	366	1846	62, 088
1816	16, 152	1847	64, 980
1817	8, 765	1848	61, 468
1818	33, 379	1849	66, 203
1819	12, 721	1850	105, 060
1820	18, 547	1851	91, 871
1821	26, 694	1852	103, 039
1822	36, 974	1853	108, 205
1823	16, 768	1854	91, 984
1824	26, 981	1855	690, 766
1825	30, 472	1856	534, 846
1826	60, 083	1857	607, 054
1827	52, 341	1858	1, 985, 223
1828	60, 452	1859	1, 048, 246
1829	129, 647	1860	1, 664, 122
1830	36, 601	1801	2, 375, 029
1831	55, 755	1862	1, 098, 546
1832	105, 774	1863	1, 026, 038

Copper and copper ore of domestic production exported from the United States, 1864 to 1890, inclusive.

[Cwts. are long hundred-weights of 112 pounds.]

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Ore.		Pigs, bars, sheets, and old.		Manufactured.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Cwts.		*Pounds.*			
1864	109, 581	$181, 298	102, 831	$43, 229	$208, 043	$432, 570
1865	225, 197	553, 124	1, 572 382	709, 106	282, 640	1, 544, 870
1866	215, 080	792, 450	123, 444	33, 553	110, 208	936, 211
1867	87, 731	317, 791	(a)4, 637, 867	303, 048	171, 062	791, 901
1868	92, 612	442, 921	1, 350, 896	327, 287	152, 201	922, 409
1869	121, 418	237, 424	1, 134, 360	233, 932	121, 342	592, 698
1870	(a)19, 198	537, 505	2, 214, 658	385, 815	118, 926	1, 042, 246
1871	(a)54, 445	727, 213	581, 650	133, 020	55, 198	915, 431
1872	35, 564	101, 752	267, 868	64, 844	121, 139	287, 735
1873	45, 252	170, 365	38, 958	10, 423	78, 288	259, 076
1874	13, 328	110, 450	503, 160	123, 457	233, 301	467, 208
1875	(a)51, 305	729, 578	5, 123, 470	1, 042, 536	43, 152	1, 815, 266
1876	15, 304	84, 471	14, 304, 160	3, 098, 395	343, 544	3, 526, 410
1877	21, 432	109, 451	13, 461, 553	2, 718, 213	195, 730	3, 023, 394
1878	32, 947	169, 020	11, 297, 876	2, 102, 455	217, 446	2, 488, 921
1879	23, 070	102, 152	17, 200, 739	2, 751, 153	79, 900	2, 933, 205
1880	21, 623	55, 763	4, 206, 258	667, 242	126, 213	849, 218
1881	9, 958	51, 499	4, 865, 407	786, 860	38, 036	876, 395
1882	25, 936	89, 515	3, 340, 531	565, 295	93, 646	748, 456
1883	112, 923	943, 771	8, 221, 363	1, 293, 947	110, 286	2, 348, 004
1884	386, 140	2, 930, 895	17, 044, 760	2, 527, 829	137, 135	5, 595, 859
1885	432, 300	4, 739, 601	44, 731, 858	5, 339, 887	107, 536	10, 187, 024
1886	417, 520	2, 341, 164	19, 553, 421	1, 968, 772	76, 386	4, 386, 322
1887	501, 280	2, 774, 464	12, 471, 898	1, 247, 928	92, 064	4, 114, 456
1888	794, 960	6, 779, 294	81, 706, 527	4, 906, 805	211, 141	11, 897, 240
1889	818, 500	8, 226, 206	16, 813, 410	1, 896, 752	86, 764	10, 209, 722
1890	431, 411	4, 413, 067	10, 971, 899	1, 365, 379	139, 949	5, 918, 395

a Evidently errors in quantities.

Value of brass and its manufactures exported from the United States, 1867 to 1890, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.	Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Value.
1867	$12, 864	1875	$1, 000, 029	1883	$287, 847
1868	16, 841	1876	256, 974	1884	301, 014
1869	40, 063	1877	327, 817	1885	538, 118
1870	169, 997	1878	589, 451	1886	183, 686
1871	210, 816	1879	200, 871	1887	275, 019
1872	229, 458	1880	183, 468	1888	327, 170
1873	494, 575	1881	216, 057	1889	366, 739
1874	503, 531	1882	322, 439	1890	395, 950

Exports of copper ore, matte, ingot, sheets, and manufactures of copper for the calendar years 1886, 1887, 1888, 1889, and 1890.

Articles.	1886.		1887.	
	Quantity.	Value.	Quantity.	Value.
Ore and matte..........long tons..	20, 876	$2, 341, 164	25, 064	$2, 774, 464
Ingots, bars, and old......pounds..	19, 504, 087	1, 960, 189	12, 347, 507	1, 223, 260
Sheets........................do....	49, 334	8, 583	123, 886	24, 668
All other manufactures of.........	....	76, 386	....	92, 064
Total	....	4, 386, 322	....	4, 114, 456

Articles.	1888.		1889.		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ore and matte, long tons..	39, 748	$6, 779, 294	45, 836	$8, 226, 206	24, 159	$4, 413, 067
Ingots, bars and old, pounds	31, 664, 046	4, 899, 423	16, 786, 418	1, 890, 589	10, 890, 058	1, 346, 401
Sheets..........pound, ..	42, 481	7, 382	26, 902	6, 163	81, 841	18, 978
All other manufactures of......................	....	211, 141	....	86, 764	....	139, 949
Total	....	11, 897, 240	....	10, 209, 722	....	5, 918, 395

THE COPPER MARKETS.

The following table summarizes the highest and lowest prices obtained for Lake copper monthly in the New York markets from 1860 to 1890, both inclusive:

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 to 1890.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	24	23½	24	23¾	23¾	23	23⅛	23	23¼	22¼	22¼	21¾
1861	20	19	19½	19	19¾	19½	19¾	19	19¾	19¼	19	18
1862	28	27	28	25	25	23	23	21⅛	21⅛	20¼	23	20¾
1863	35	31	37	35	37	31	31	30	30⅛	30	30⅛	30
1864	41¼	39	42	41¼	42⅛	41⅛	44	42⅛	44	43	49	44
1865	50½	46	46	44	44⅛	34	35	34	34	30	30⅛	28⅛
1866	42	38	38	35⅛	35⅛	29⅛	30	28⅛	31	29	33	31
1867	29¼	27	27¾	27⅛	27⅛	24	24⅛	23⅛	24¼	24	24⅛	24
1868	23⅜	21⅛	24	22⅛	24	23¼	24¼	23¼	24¼	24	24	23⅛
1869	26¼	23¾	27	26	26¾	24	24	23¼	24¼	23¾	23¾	22
1870	22	21⅛	21¼	20⅞	20¾	19	19¾	19¼	19⅛	19	20⅝	19
1871	22⅞	22	22⅜	21⅞	22	21⅛	21¾	21¼	21⅜	21⅝	21⅛	21¼
1872	28⅛	27⅛	28⅜	28¼	30⅛	28⅜	44	30⅛	42	36	34⅛	33
1873	35	32⅛	35	34	35	34⅛	34⅛	33⅛	33⅛	32	31⅛	29⅛
1874	25	24⅛	25	24⅛	24⅜	24	25	24¾	25	24⅛	24¾	24¼
1875	23⅛	21⅛	22¾	21¾	21¾	21⅛	21¾	21⅛	23¼	22⅝	23	23
1876	23¼	23	22⅞	22⅛	22¼	22	22⅝	22	22⅛	21	21	19¼
1877	19⅜	19	20⅛	19⅜	19⅛	19	19⅛	19¼	19¼	19	19⅝	19
1878	17⅝	17¼	17⅛	17⅛	17⅛	16⅞	17	16⅞	16¼	16¼	16⅝	16¼
1879	16	15½	15⅛	15⅛	15¾	15¾	16	15¾	16¼	16	16¼	16⅛
1880	25	21⅜	24⅛	24	24	22¾	22⅛	24	21	18	18⅛	17⅞
1881	19⅜	19⅛	19⅜	19⅛	19⅜	19	19	18⅜	18⅞	18¼	18¼	16⅝
1882	20⅝	20¼	20	19	19¼	18⅞	18⅞	17⅞	18¼	18	18¼	18
1883	18⅛	18	17⅞	17¾	17⅝	17⅛	16	15⅝	16	15⅞	15⅞	15
1884	15	14⅞	15	14⅞	15	14⅞	15	14⅛	14¼	14⅛	14¼	14
1885	11½	10⅝	11⅛	10⅝	11⅛	10⅝	11¼	$10\frac{1}{10}$	11⅛	9⅝	11⅛	11
1886	11⅝	11⅜	11⅝	11⅜	11⅛	11⅝	11⅛	11⅝	11⅛	10	10⅛	10
1887	12	11⅛	11⅛	10⅝	10⅝	10⅝	10⅛	10	10	$9\frac{13}{16}$	10¼	10
1888	$17\frac{4}{10}$	$15\frac{17}{20}$	$16\frac{6}{10}$	16	$16\frac{7}{10}$	$15\frac{9}{16}$	$16\frac{9}{10}$	16	16¾	$16\frac{3}{10}$	$16\frac{13}{16}$	$16\frac{9}{20}$
1889	17⅛	16⅛	16¾	16⅛	15¾	15	16	15⅛	12⅛	12	12¼	12
1890	14⅛	14¼	14¼	14¼	14¼	14	14⅛	14¼	15¼	14⅝	16¾	15¼

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	21¾	21⅛	21⅛	21⅛	22	21¼	22	21⅛	21⅛	20¼	20¼	19¾
1861	18	17⅛	19	17⅜	20¼	19	20¼	20	22⅜	20¼	27	22⅛
1862	24⅛	22⅛	24⅛	24	27	24¼	32⅞	27	32⅞	30⅛	31⅛	30⅛
1863	32	29	31	29	32¼	31	34⅛	32¼	38⅛	34⅛	38¾	38⅛
1864	55	49	52⅛	50	52⅛	47⅛	48	47	49	47	50	48⅛
1865	30¼	28	32	30⅛	32⅜	31⅛	33	32⅛	45⅛	33	45⅛	39¼
1866	33⅛	31	31	30	31⅛	30⅜	31	30¾	30¼	26⅛	29	26⅛
1867	26	24	26¼	25⅜	27¼	26¼	26¾	22¾	23	22⅞	23	21⅛
1868	24⅛	23⅛	24¼	24	24	23⅜	24	23	24	22⅛	24⅛	23⅜
1869	22¼	21⅞	23⅛	21⅞	23	22	22⅜	22	22⅛	22	22	21⅛
1870	20⅛	20⅜	21⅜	20⅛	21⅛	20⅜	21⅜	21⅛	23⅜	21⅜	22⅝	22¼
1871	22¼	21⅝	23	22⅜	23⅞	22⅞	23⅞	23¼	24¼	23¼	27	24⅛
1872	34	33	35	32⅛	35¼	33	34⅜	31¼	32¼	30¾	32⅛	30⅛
1873	29	26⅝	27⅛	27	27	25⅛	25⅛	24	24	21	25	23
1874	24¼	20	21	19	21¼	21	22¼	21¼	23⅜	22¼	23¼	23¼
1875	23	22⅝	23⅜	23	23⅞	23⅛	23¼	23	23¼	23	23⅜	23⅜
1876	20	19⅛	19⅛	18¾	21	18¾	21¼	20⅛	20⅛	20	20	19⅝
1877	19¼	19	19	17⅞	18⅛	17⅞	18	17⅜	17⅜	17⅝	17¾	17⅛
1878	16¼	16	16	16	16¼	16	16	15⅛	15⅞	15⅜	16	15⅞
1879	16⅛	16	16⅜	16	17	16¼	21⅛	18	21⅜	21	21⅛	21
1880	18⅞	18⅛	19⅛	19	18⅞	18⅜	18⅞	18¾	18⅞	18¾	19⅛	18⅞
1881	16⅛	16	16⅝	16⅜	18⅛	16¾	18⅞	18	19	18⅛	20⅝	19⅛
1882	18¼	18⅛	18¼	18⅛	18¼	18	18¼	18	18⅛	18	18	17⅞
1883	15⅛	15	15	15	15¼	15⅛	15¼	15⅛	15	14⅞	15	14⅞
1884	14⅛	13⅞	14	13⅞	13⅛	13	13⅛	12⅞	13	12⅛	12⅛	11
1885	11¼	10⅞	11¼	11	11⅛	$10\frac{13}{16}$	11⅛	10⅝	11⅛	10⅝	11⅛	$11\frac{1}{10}$
1886	10⅛	10	10¼	10	11⅛	10¼	11¾	11⅛	12	11⅜	12⅛	11⅞
1887	10¾	10⅛	10¾	10⅜	11	10⅝	$12\frac{3}{20}$	$10\frac{3}{10}$	$14\frac{13}{16}$	$11\frac{11}{16}$	17⅜	$14\frac{13}{16}$
1888	$16\frac{9}{10}$	$16\frac{13}{16}$	17	16⅜	$17\frac{7}{10}$	$16\frac{9}{10}$	17⅜	$17\frac{7}{20}$	17⅜	17¼	$17\frac{9}{20}$	$17\frac{1}{10}$
1889	12	12	12	12	12	11	11	11	13¼	11¼	14⅛	14
1890	17¼	16⅛	17¼	17	17	17	16⅞	16¾	16¾	16¾	16	15

In some months, notably those immediately preceding and following the collapse of the syndicate, in 1889, the prices were merely nominal. A good illustration of the rates obtained for Lake copper is contained in the following table compiled from the reports of a number of the Lake companies:

Prices realized for Lake copper in 1888, 1889, and 1890.

[Cents per pound.]

Mines.	1888.		1889.		1890.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.		*Pounds.*		*Pounds.*	
Allouez	314,198	13.71	1,762,816	12.08	1,407,828	14.73
Franklin	3,655,751	15.07	3,300,667	12.05	2,529,542	14.80
Atlantic	3,974,972	14.78	3,698,837	12.09	2,821,616	15.21
Central	1,817,023	14.80	1,270,592	12.57	1,413,391	14.94
Huron	2,414,169	14.92	1,900,081	12.83	1,375,000	14.86
Osceola	4,134,320	15.03	4,534,127	11.94	5,294,792	15.51
Quincy	6,367,809	15.93	6,405,686	11.96	8,064,253	15.36
Kearsarge	829,185	16.60	1,918,849	12.58	1,598,525	15.08
Tamarack (*a*)	11,036,469	12.90	8,928,249	11.99	14,076,957	14.01

a Fiscal years ending June 30, 1889, 1890, and 1891.

The figures furnish the means for estimating fairly well the average prices obtained for the different years. They do not, however, cover the sales of the largest producer, but it may be stated that the average prices realized were 12 cents in 1889 and 15 cents in 1890.

As covering the longest period, the report of the yearly sales of the Osceola are the most interesting in showing the fluctuations in the price of Lake copper. Since 1874 the sales of this company have been as follows:

Sales of copper and average prices by the Osceola Mining Company, 1874 to 1890.

Years.	Sales.	Average price.	Years.	Sales.	Average price.
	Pounds.	*Cts. per lb.*		*Pounds.*	*Cts. per lb.*
1874	936,002	23.37	1883	4,256,409	14.96
1875	1,330,313	22.77	1884	4,247,630	12.82
1876	1,693,737	20.57	1885	1,639,169	10.75
1877	2,774,777	18.19	1886	3,560,786	10.51
1878	2,705.998	15.53	1887	3,583,723	11.86
1879	3,197.387	17.79	1888	4.134,320	15.03
1880	3,381,061	19.15	1889	4.534,127	11.94
1881	4,176,976	17.77	1890	5,294,792	15.51
1882	4,179,782	17.70			

The principal events in the copper market during 1890 were closely associated with the marketing of the syndicate metal controlled by the guaranteeing bankers. On the whole, the operations were conducted judiciously and were greatly aided by the rising tendency, created by the enormous demand on the part of the manufacturers. January opened with Lake copper at 14.25 cents, at which banker's copper was put on the market. A rising tendency developed during the month, aided by the attitude of the mining companies, who were holding at 15 cents. February was quieter, with a somewhat weaker market, largely created by the offering of copper by second hands. The market remained quiet in the early part of March at 14⅛ to 14¼ cents, until the announcement was made that the mining companies had contracted with manufacturers for a large quantity for April, May, and June delivery at 14 cents, which was followed later in the month by the selling of about 2,000,000 pounds of banker's stock at 14¼ cents. The market fluctuated in the early part of April between 14⅛ and 14¼ cents for Lake, casting brands being quoted at 12⅜ to 12½ cents. A further opportunity was offered during this month to the bankers to dispose of about 8,000,000 pounds, followed early in May by the placing of 2,000,000 pounds of Arizona copper. The market rose rapidly from 14½ cents early in the month of May to 15 cents, near which figure additional banker's stock was placed on the market, the month closing with an active demand at 15¼ cents for prompt delivery of Lake copper and 13.35 cents for casting brands. June witnessed the closing out of all that part of the bankers' stock not tied up by litigation, about 5,000 tons of Lake copper, and large sales by the mining companies at rapidly advancing prices, the month closing with 16¾ cents asked for Lake and 14½ cents for casting copper. During the same month very large quantities, about 20,000 tons, of matte were disposed of by the heirs of the syndicate. Although there were some offerings from second hands to realize profits on a rising market, the price of copper rose steadily in July until 17¼ cents was reached at its close for Lake copper and 14¾ cents for casting brands. Operations on a very large scale were carried through in England, the bankers disposing of close upon 25,000 tons of metal in the English and French markets. The demand became less urgent in August, and although the mining companies made large sales for September and October, delivery in September at 17 cents, followed by further purchases by the consumers at full prices in October, the market showed a weakening tendency, which was more pronounced in casting than in Lake copper, the market entering November with the former at 14 cents and the latter to 16¾. The financial crash in Europe and its serious effect upon business in all lines in this country told on copper, which declined slowly to 16½ cents during the month, the Lake companies withholding from the market entirely. The weakness became more pronounced in December, and although producers sold at 17 cents considerable quantities for forward delivery, they undertook to protect consumers against a decline, which developed rapidly, the year closing with Lake copper offering at 15 cents, export sales at 14 cents, and casting brands seeking a market at 13 cents.

The fluctuations in the price of copper during the past decade in the English market are shown in the following table:

Average values of copper in England.

Years.	Chile bars, or G. O. B.			Ore, 25 per cent.			Precipitate.		
	Long ton.			*Per unit.*			*Per unit.*		
	£	s.	d.	£	s.	d.	£	s.	d.
1880	62	10	0	0	12	9	0	12	11
1881	61	10	0		12	6		13	8 3/16
1882	66	17	0		13	6¾		13	10 1/16
1883	63	5	10		12	4¼		12	10 1/16
1884	54	9	1		10	5½		11	1
1885	44	0	10		8	4		9	0½
1886	40	9	3		7	9		8	3¾
1887	43	16	11		8	6		8	11¾
1888	79	19	4½		14	3½		16	3
1889	49	10	5		9	6¼	....		
1890	54	5	5		10	7	....		

THE PRINCIPAL FOREIGN PRODUCERS.

The copper production of the world, 1883 to 1890, inclusive.

Countries.	1890.	1889.	1888.	1887.	1886.	1885.	1884.	1883.
EUROPE.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Great Britain	(a)1,000	905	(a)1,500	389	1,471	2,773	3,350	2,620
Spain and Portugal:								
Rio Tinto	30,000	29,500	(a)32,000	26,663	(a)24,700	23,484	21,564	20,472
Tharsis	(a)10,300	(a)11,000	(a)11,500	(a)11,000	(a)11,000	(a)11,500	(a)10,800	9,800
Mason & Barry	(a)5,600	(a)5,250	(a)7,000	(a)7,000	(a)7,000	(a)7,000	(a)7,500	8,000
Sevilla	870	1,850	1,700	2,300	2,135	1,800	2,000	2,026
Portugueza	(a)1,200	1,200	(a)900	(a)856	1,258	1,665	(a)2,300	2,357
Poderosa and others	(a)4,225	(a)6,500	(a)7,200	4,050	3,560	2,424	2,251	1.000
Germany:								
Mansfeld	15,800	15,506	13,380	13,025	12,595	12,450	12,582	12,634
Other German	(a)2,000	(a)1,850	(a)1,850	(a)1,850	1,870	(a)2,800	(a)2,200	3,568
Austria	1,210	1,225	1,010	883	733	585	670	572
Hungary	(a)300	(a)300	858	531	366	504	614	661
Sweden	(a)800	830	(a)900	905	520	775	662	732
Norway	(a)1,375	1,357	1,570	1,450	2,220	2,560	2,706	2,630
Italy	3,000	3,500	(a)2,500	(a)2,500	900	835	1,325	1,600
Russia	4,800	4,070	4,700	5,000	4,875	(a)5,100	4,700	3,500
Total Europe	82,480	84,843	88,568	78,402	75,203	76,255	75,224	72,172
NORTH AMERICA.								
United States	115,669	109,918	101,054	81,017	70,430	74,052	64,708	51,574
Canada	3,050	2,500	(a)2,250	1,400	1,440	2,500	236	1,055
Newfoundland	1,735	2,615	2,050	1,180	1,125	778	668	1,053
Mexico	4,325	3,780	2,766	2,050	850	375	291	489
Total North America	124,779	109,813	108,120	85,647	73,845	77,705	65,903	54,171
SOUTH AMERICA.								
Chile	26,120	24,250	31,240	29,150	35,025	38,500	41,648	41,099
Bolivia:								
Corocoro	(a)500	(a)1,200	1,450	(a)1,300	1,100	(a)1,500	(a)1,500	1,680
Peru	150	275	250	50	75	229	362	395
Venezuela:								
New Quebrada	6,370	6,068	4,000	2,900	3,708	4,111	4,600	4,018
Argentine Republic	150	190	150	170	180	233	159	293
Total South America	33,290	31,983	37,090	33,570	40,088	44,573	48,269	47,485
AFRICA.								
Algiers	120	160	50	150	110	250	260	600
Cape of Good Hope	6,450	(a)7,700	7,500	7,250	6,015	5,450	5,000	5,975
Total Africa	6,570	7,860	7,550	7,400	6,125	5,700	5,260	6,575

a Estimated.

The copper production of the world, 1883 to 1890, inclusive—Continued.

Countries.	1890.	1889.	1888.	1887.	1886.	1885.	1884.	1883.
ASIA.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Japan	15,000	15,000	(*a*)11,000	(*a*)11,000	10,000	(*a*)10,000	(*a*)10,000	7,609
Total Asia	15,000	15,000	11,000	11,000	10,000	10,000	10,000	7,600
AUSTRALIA.								
Australia	7,500	8,300	7,550	7,700	9,700	11,400	14,100	12,271

a Estimated.

RECAPITULATION.

Countries.	1890.	1889.	1888.	1887.	1886.	1885.	1884.	1883.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Europe	82,480	84,843	88,568	78,402	75,203	76,255	75,224	72,172
North America	124,779	109,813	108,120	85,647	73,845	77,705	65,903	54,171
South America	33,290	31,983	37,090	33,570	40,088	44,573	48,269	47,485
Africa	6,570	7,860	7,550	7,400	6,125	5,700	5,260	6,575
Asia	15,000	15,000	11,000	11,000	10,000	10,000	10,000	7,600
Australia	7,500	8,300	7,550	7,700	9,700	11,400	14,100	12,271
Total	269,619	257,799	259,878	223,719	214,961	225,633	218,756	200,274

With the exception of the figures for the United States the data in the above table were taken from the annual statistics of Messrs. Henry R. Merton & Co., of London. In 1890 the United States produced 42.9 per cent. of the whole output of the world against 22.4 per cent. in the year 1882, when production statistics were first carefully collected.

British imports and exports of copper.

Years.	Imports of—		Total imports.	Exports.	Apparent English consumption.
	Bars, cakes, and ingots.	Copper in ores and furnace products.			
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1860	13,142	13,715	26,857	26,117	....
1865	23,137	23,922	47,059	41,398	....
1870	30,724	27,025	57,749	53,006	....
1871	33,228	23,671	56,899	56,633	....
1872	49,000	21,702	70,702	53,195	....
1873	35,840	26,756	62,596	55,716	....
1874	39,906	27,894	67,800	59,742	....
1875	41,931	29,483	71,414	51,870	....
1876	39,145	36,191	75,336	52,468	....
1877	39,743	53,582	93,325	54,088	....
1878	39,360	48,212	87,572	55,001	....
1879	46,670	50,421	97,091	62,412	30,774
1880	36,509	56,225	92,734	59,482	32,879
1881	32,170	54,057	86,227	61,689	31,607
1882	35,509	58,366	93,875	55,683	42,877
1883	35,653	63,493	99,146	59,350	40,469
1884	39,767	69,623	109,390	64,691	51,263
1885	41,933	81,616	123,549	62,080	54,323
1886	42,969	65,046	108,015	60,511	41,158
1887	29,198	73,891	103,089	69,453	53,096
1888	44,603	90,867	135,470	(*a*)72,066	42,562
1889	(*b*)38,576	101,407	139,983	75,627	65,759
1890	(*c*)49,461	91,788	141,249	89,747	66,170

a Including 22,557 tons of Chile bars transferred to France.
b Including 1,166 tons of Chile bars transferred from France to England.
c Including 3,501 tons of Chile bars transferred from France to England.

The following figures from the Board of Trade returns for the past nine years show in detail the form in which the copper is brought into Great Britain and in what form it is exported:

Imports of copper into Great Britain from 1882 to 1890, inclusive.

Character.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pure in pyrites	15,672	15,016	14,077	16,333	13,905	14,940	15,448	16,097	16,422
Pure in precipitate	17,935	23,645	19,688	21,398	19,323	21,819	26,366	25,110	25,563
Pure in ore	15,489	15,880	24,677	15,683	13,749	15,148	19,452	22,219	18,000
Pure in regulus	9,270	8,952	11,181	28,202	18,069	21,984	29,601	37,981	31,803
Bars, cakes, etc	35,509	35,653	39,767	41,933	42,969	29,198	44,603	(*a*)38,576	49,461
Total	93,875	99,146	109,390	123,549	108,015	103,089	135,470	139,983	141,249

a Including 1,166 tons of Chile bars transferred from France to England.

The following table gives the details relating to the British imports of precipitate and regulus:

Imports of precipitate and regulus into Great Britain from 1882 to 1890, inclusive.

Countries.	1882.	1883.	1884.	1885.	1886.	Fine copper.	1887.	Fine copper.	1888. Fine copper.	1889. Fine copper.	1890. Fine copper.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Portugal	7,301	8,873	7,161	8,283	6,657	24,032	10,758	24,754	30,119	28,157	28,018
Spain	21,398	28,962	27,621	38,267	38,666		37,892				
Chile	10,882	6,384	10,699	5,255	1,637	737	1,595	718	784	1,919	2,122
United States	......	......	5,805	29,861	16,105	10,853	24,229	15,039	20,752	26,581	18,897
Other countries	9,716	13,509	11,124	6,000	5,240	1,770	5,366	2,292	4,362	6,434	8,329
Total	49,297	57,728	62,410	87,666	68,305	......	79,840	......	......	......	......
Fine copper	27,205	32,597	34,172	49,600	......	37,392	......	42,803	55,967	63,091	57,366

The notable feature is the heavy increase in receipts of fine copper in matte from the United States in 1889 and the falling off in 1890.

In detail, the imports of copper in the form of bars, cakes, etc., into Great Britain were as follows:

Imports of copper, wrought and unwrought, into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chile	24,258	21,019	22,585	22,799	22,843	24,832	24,748	17,516	21,534	17,631	19,716
Australia	9,406	9,150	8,152	9,531	9,329	8,564	9,933	5,412	5,398	5,567	5,355
America	......	......	......	1,773	3,584	3,375	2,110	1,469	4,680	3,799	1,269
Other countries	2,845	2,001	4,772	1,550	4,011	5,160	6,178	4,801	12,991	(*a*)11,575	23,121
Total	36,509	32,170	35,509	35,653	39,767	41,931	42,969	29,198	44,603	38.572	49,461

a Including 1,166 tons of Chile bars transferred from France to England.

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of other than Chile copper into Liverpool, London, and Swansea during the years 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889 and

1890, which represents the total imports, with the exception of precipitate, into Newcastle and Cardiff, reliable returns of which can not be obtained, but which is estimated to vary from 8,000 to 10,000 tons fine per annum:

Imports of copper product into Liverpool, Swansea, and London.

Countries.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chile	30,112	27,504	31,298	28,985	27,191	20,008	24,479	22,070	22,909
United States	745	9,410	17,309	24,037	13,483	16,534	25,730	30,729	20,171
Spain and Portugal	464	2,788	2,359	4,655	5,721	5,178	5,915	5,189	5,202
Spain (precipitate)	8,757	11,249	10,009	9,186	10,038	13,042	15,568	17,192	18,430
Spain (pyrites)	15,673	15,017	14,077	16,333	13,905	14,940	15,448	16,097	16,422
Australia	9,847	9,694	9,685	8,951	10,096	6,047	6,746	6,285	6,561
Cape of Good Hope	5,298	5,670	6,042	5,405	7,073	8,271	8,829	11,507	9,927
New Quebrada	3,164	3,960	3,675	4,074	3,055	2,261	3,574	4,299	5,245
Japan	....	....	1,064	3,010	3,572	200	4,469	2,523	10,674
Italy	1,386	1,091	1,310	835	889	1,055	1,058	1,043	953
Norway	446	296	289	27	....	....	545	234	80
Canada	347	448	266	....	8	94	156	181	264
Newfoundland	1,362	1,185	224	723	891	359	465	631	1,552
Mexico	372	489	291	374	243	61	158	3,938	3,325
Peru	821	426	408	229	68	13	202	271	254
River Platte	260	319	131	233	179	167	135	184	143
Other countries	925	946	284	325	1,049	1,074	4,054	1,389	225
Total tons fine	70,979	90,492	98,721	107,382	97,461	89,304	117,531	123,762	122,837

In spite of a decline in 1890 of receipts from the United States to the extent of over 10,000 tons, the imports nearly reached the exceptionally high figure for 1889.

The following table, giving the details of the imports of copper from the United States into England and France, for a series of years in different forms, is particularly interesting as showing how closely this country is pushing Chile as a rival contributor to the world's markets:

Imports of copper from the United States in England and France.

	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
England:									
Ore	274	4,940	11,023	1,875	420	26	298	349	5
Matte	471	2,512	2,722	18,895	10,853	15,039	20,752	26,581	18,897
Bars and ingots	....	1,773	3,584	3,375	2,210	1,469	4,680	3,799	1,269
Total	745	9,225	17,329	24,145	13,483	16,534	25,730	30,729	20,171
France	1,072	4,513	7,205	9,235	4,167	3,910	6,496	1,058	1,733
United States into England and France	1,817	13,738	24,534	33,380	17,650	20,444	32,226	31,787	21,904
Chile into England and France	42,306	43,568	42,384	35,342	35,448	29,019	32,947	22,020	24,641

The exports of copper from Great Britain in different forms were as follows:

Exports of copper from Great Britain from 1882 to 1890, inclusive.

Character.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Loag tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Raw English	12, 776	16, 777	17, 943	18, 766	19, 036	40, 700	32, 058	48, 189	58, 571
Sheets	15, 698	16, 071	20, 669	21, 108	17, 927				
Yellow metal, at 60 per cent	10, 892	11, 918	11, 602	12, 551	11, 958	10, 153	4, 513	9, 195	10, 514
Brass, at 70 per cent	3, 499	3, 381	3, 735	3, 233	3, 001	3, 146	2, 650	3. 773	3, 721
Total	42, 865	48, 147	53, 949	55, 658	51, 922	53, 999	39, 221	61, 157	72, 806
Fine foreign	12, 818	11, 203	10, 742	6, 422	8, 589	15, 454	[a]32, 845	14, 470	16, 941
Total	55, 683	59, 350	64, 691	62, 080	60, 511	69, 453	72, 066	75, 627	89, 747

[a] Including 22,557 tons Chile bars transferred to France.

FRANCE.

The direct imports of copper from different countries into France were as follows, for a series of years:

Direct imports into France, from 1883 to 1890, inclusive.

Countries.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chile	16, 064	11, 086	6, 357	8, 257	9, 011	8, 468	2, 470	2, 803
United States	4, 513	7, 205	9, 235	4, 167	3, 910	6, 496	1, 058	1, 733
Mexico	....	....	....	....	....	2, 700	738	....
Other countries	317	392	995	1, 600	1, 048	6, 905	1, 715	975
Total	20, 894	18, 683	16, 587	14, 024	13, 969	24, 569	5, 981	5, 511

These statistics do not, of course, include the quantities, notably of Chile copper, transferred from English to French warehouses. The heavy decline in the imports of France during 1889 and 1890, is due to the fact that the accumulations of the syndicate are being drawn upon.

LEAD.

BY C. KIRCHHOFF.

The maximum production in the United States was reached in the year 1889, when the smelting works and refining establishments in the United States made 182,967 tons of lead. Making allowance for the lead contents in Mexican ores imported, the output of metal from American ores rose from about 145,000 tons in 1887 to 152,000 tons in 1888 and to 156,000 tons in 1889. In 1890 a marked decline took place, the gross product falling from 182,967 tons in 1889 to 161,754 tons in 1890; or, deducting the metal contents of the Mexican ores, from 156,397 to 143,630 tons. The gross production of refined lead since 1887 and the metal contents of Mexican ores has been as follows:

Production of lead in the past four years.

Years.	Gross production.	Lead contents of Mexican ores.	Net American product.
	Tons.	*Tons.*	*Tons.*
1887	160,700	(*a*) 15,000	145,700
1888	180,555	28,636	151,919
1889	182,967	26,570	156,397
1890	161,754	18,124	143,630

a Estimated.

The following table presents the figures of production of lead in the United States from 1825. Up to the year 1882 the figures have been compiled from the best data available. Since 1882 the statistics are those collected by this office, with the exception of the year 1889, when they were gathered by the Census Office.

Production of lead in the United States from 1825 to 1890, both inclusive.

Years.	Total production. (Short tons.)	Desilverized lead. (Short tons.)	Non argentiferous lead. (Short tons.)	Percentage of desilverized lead.
1825	1,500			
1830	8,000			
1831	7,500			
1832	10,000			
1833	11,000			
1834	12,000			
1835	13,000			
1836	15,000			
1837	13,500			
1838	15,000			

Production of lead in the United States from 1825 to 1890, both inclusive—Continued.

Years.	Total production. (Short tons.)	Desilverized lead. (Short tons.)	Non-argentiferous lead. (Short tons.)	Percentage of desilverized lead.
1839	17,500	....	....	....
1840	17,000	....	....	....
1841	20,500	....	....	....
1842	24,000	....	....	....
1843	25,000	....	....	....
1844	26,000	....	....	....
1845	30,000	....	....	....
1846	28,000	....	....	....
1847	28,000	....	....	....
1848	25,000	....	....	....
1849	23,500	....	....	....
1850	22,000	....	....	....
1851	18,500	....	....	....
1852	15,700	....	....	....
1853	16,800	....	....	....
1854	16,500	....	....	....
1855	15,800	....	....	....
1856	16,000	....	....	....
1857	15,800	....	....	....
1858	15,300	....	....	....
1859	16,400	....	....	....
1860	15,600	....	....	....
1861	14,100	....	....	....
1862	14,200	....	....	....
1863	14,800	....	....	....
1864	15,300	....		....
1865	14,700	....		....
1866	16,100	....		....
1867	15,200	....		....
1868	16,400	....		....
1869	17,500	....	....	....
1870	17,830	....	....	....
1871	20,000	....	....	....
1872	25,880	....	....	....
1873	42,540	20,159	22,381	47.39
1874	52,080	....	....	....
1875	59,640	34,909	24,731	58.53
1876	64,070	37,649	26,421	58.76
1877	81,900	50,748	31,152	61.96
1878	91,060	64,290	26,770	70.60
1879	92,780	64,650	28,130	69.68
1880	97,825	70,135	27,690	71.69
1881	117,085	86,315	30,770	73.72
1882	132,890	103,875	29,015	78.17
1883	143,957	122,157	21,800	84.86
1884	139,897	119,965	19,932	85.75
1885	129,412	107,437	21,975	83.02
1886	135,629	114,829	20,800	84.66
1887	160,700	135,552	25,148	84.35
1888	180,555	151,465	29,090	83.89
1889	182,967	153,709	29,258	84.01
1890	161,754	130,903	31,351	80.62
1891(*a*)	95,121	79,301	15,820	83.37

a First half.

Producers carried on the 1st of January, 1891, a stock of 10,389 short tons, as compared with 7,715 short tons on the 1st of January, 1890. It must be considered, however, that practically the bankers' stock of about 8,000 tons went into consumers' hands.

The census report for the calendar year 1889 possesses particular interest because it gives the results of a comprehensive effort to ascertain the sources, territorially, of the lead produced in the United States. Some statisticians have still clung to the hope, long abandoned by this office, of distributing the lead product territorially on the basis of the returns of lead smelters. How impossible this is may be inferred from the fact that the desilverizers and refiners at Omaha, Kansas City, Aurora, Chicago and St. Louis, at a great distance from the producing States and Territories, smelted Rocky Mountain and foreign ores which yielded 33,638 tons of base bullion. How little the product of smelters in a State reflect the lead contents of the ores mined in its territory is evidenced by the fact that the census returns show the lead contents of Idaho ores to have been 23,172 tons, while its smelters produced only 878 tons. Arizona shipped ore to other States containing 3,158 tons of lead and yet did not do any smelting. Montana is credited with an ore product carrying 10,183 tons of metal, and yet its smelters produced 19,404 tons of base bullion. Utah works some Nevada ores, but in spite of that fact it made only 12,908 tons of base bullion, while the lead contents of its ores was 16,675 tons. The following table presents the result of the investigation made by the Census Office to ascertain the lead contents of the ores mined in the mountain States and Territories:

Lead contents of ores mined in the Western States and Territories in 1889.

States.	Short tons.
Arizona	3,158
California	53
Colorado	70,788
Idaho	23,172
Montana	10,183
Nevada	1,994
New Mexico	4,764
South Dakota	116
Utah	16,675
Total	130,903

The following is a list of the counties which in the census year produced ore containing an aggregate of more than 1,000 tons:

States and counties.	Short tons.
Arizona:	
Cochise	1,274
Pima	1,152
Colorado:	
Chaffee	3,307
Clear Creek	1,539
Gilpin	1,013
Lake	50,492
Ouray	1,333
Pitkin	7,132
San Juan	1,787
Summit	1,596
Idaho:	
Alturas	1,219
Logan	2,751
Shoshone	18,564
Montana:	
Beaverhead	3,453
Jefferson	5,081
Meagher	1,060
Nevada:	
Eureka	1,489
New Mexico:	
Dona Ana	1,029
Grant	1,618
Socorro	1,187
Utah:	
Beaver	4,487
Salt Lake	4,794
Summit	5,681
Tooele	1,483

These figures well illustrate how widely scattered the sources of lead supply are, and how many of them, while individually unimportant, contribute a large aggregate. The lead industry is therefore losing more and more of the characteristics peculiar to it in its earlier days of development, when in turn Eureka, Utah, and Leadville swayed it, and when the markets for the metal often moved with the fortunes of individual mines. Since then the Coeur d'Alene has risen to eminence, Mexico has become an important factor, and new districts on both sides of the northwestern frontier promise to add to the sources of supply.

The soft lead product of Missouri, Kansas, and Wisconsin has remained fairly stationary. The Census report has shown that the output of lead ores from those districts in which it is associated with zinc ore is relatively unimportant. Wisconsin, with an output of 24,832 tons of zinc ore, reported only 1,678 tons of lead ore, equivalent to about 1,000 tons of lead. Kansas produced in 1889, 3,617 tons of lead ore, equal to about 2,200 tons of metal, while out of the total of 44,482 tons of lead ore mined in Missouri not less than 34,766 tons were taken from mines which did not yield any zinc. Thus roughly the total amount of lead obtained as a by-product in mining zinc ore in the three States named is 9,000 tons. This proves that so far as lead is concerned the metal is little influenced by prosperity or depression in zinc mining. It should be noted also that a part of the lead ore won as an incidental product in zinc mining is utilized in the production of sublimed lead, the quantity of the latter having been 1,250 tons during the census year. Practically the make of soft lead is controlled by the operations of the three grest Missouri lead mining companies, the St. Joe, Doe Run, and Mine La Motte, which during the census year made 21,456 short tons out of total soft lead product of 29,258 tons at a direct outlay for mining and smelting of $1,034,287. What expansion in the industry there is to be must therefore come chiefly from them, or from new concerns established to work some of the areas of the same deposits which they have so long and so successfully worked. Their ability to produce the metal under any contingencies likely to arise is generally unquestioned, so that a steady but slow development is looked forward to.

So many conditions influence the production of lead in the Rocky Mountain region that it is practically impossible to arrive at any conclusions on the question to what extent low prices will restrict and high prices stimulate the output of the metal. It is known that under favorable conditions lean lead ores, practically free from silver, may be worked when they serve as the basis for the treatment, at remunerative prices, of dry and refractory silver ores. The report of the census shows that Rocky Mountain smelters which treated 819,382 tons of ore produced 110,843 tons of base bullion, equal to a yield of the smelting mixture of between 13.50 and 14 per cent, and that, including the amount of ore treated by four refiners, the yield from 928,163 tons of ore was 144,481 tons, equal to a yield of between 15.50 and 16 per cent, making a rough allowance for the unknown silver contents and dross. The presence of the precious metals, the presence or absence of zinc, the character of the ore, whether a carbonate or a sulphide, the character of the gangue in relation to the preponderance of silica over bases, all influence the commercial value of the lead ore, aside from the cost of running, the proximity to railroad transportation and to fuel. All these considerations have their influence in determining the minimum lead contents which allow of profitable marketing of the ore. Under the circumstances, only very broad generalizations are possible, and no specific detailed examination is practicable. Past experience has taught, however, that an approach to 3 cents for refined lead at New York, with silver below $1 per ounce, exerts a pressure upon producers which leads to a restriction of output in the principal Rocky Mountain lead-producing districts.

The St. Joseph Lead Company has built a narrow-gauge railroad 32 miles long between Herculaneum and Bonne Terre, and is extending to Doe Run, and will soon be in a position to transfer its smelting operations to Herculaneum.

Under the management of Mr. J. M. Desloge, the Desloge Consolidated Lead Company is prospecting a tract of 2,300 acres of magnesian limestone similar to the Bonne Terre formation. Drilling is progressing with two diamond drills, and a shaft has been sunk to a depth of 220 feet, from which drifts, upraises and stopes have been started.

THE LEAD MARKET.

The year 1890 opened dull at 3.85 cents, but under a large business soon developed some strength. With more moderate sales, a downward tendency again developed, which was only temporarily checked early in February, and finally led to heavier transactions during that month at 3.75 cents. March brought a reaction, and the market gradually advanced to 4 cents, from which, however, it again receded to 3.82½ cents towards the close of the month. April opened dull, but an improved feeling carried the metal up to 4.05 cents, at which sales were made. The weight upon the market was the lead held by bankers, who, it was estimated, were carrying a stock of 8,000 tons, upon which advances up to 4 cents had been originally made. The market fluctuated a little early in May, and then, under consumers' buying in anticipation of a decision on the Mexican ore duty, rose to 4.32½ cents, receding towards the close of the month to 4.25 cents. Under a heavy business the metal rose again to 4.55 cents in June, the bankers being heavy sellers until their holdings of Corwith lead had been reduced to about 4,000 tons lying in Western markets. July developed a weaker tone, with only little business transpiring, and it was only towards the early part of August that there was more activity coupled with rising values. This tendency gathered strength rapidly, and in September had so fully developed that the importing point was reached—above 5 cents—and several thousand tons of foreign lead were disposed of. In spite of this the market advanced very rapidly, small lots selling up to 6 cents in October, with further transactions on a large scale in foreign lead, The reaction, however, proved as sharp and as violent as the advance, and the difference between prices for future delivery of foreign and spot domestic at one time reached nearly half a cent per pound. The drop continued in November, the month closing dull, with spot domestic lead at 4.70 cents; foreign, at 4.95 cents; and domestic, December delivery, at 4.60 cents. The financial troubles of the month had a very marked effect upon lead, so that the price declined in December from 4.60 cents down to 4.15 cents, under pretty large sales, the month and year closing with the metal back to 4.05 cents.

The following table, prepared from the annual reports of the daily price of lead, compiled by Mr. E. A. Caswell, of New York, shows the monthly average prices from 1884 to June, 1891, inclusive:

Average monthly prices of common pig lead in New York City.

[Cents per pound.]

Months.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
January	4.09	3.65	4.57	4.27	4.80	3.82½	3.82½	4.34½
February	3.98	3.65	4.75	4.43	4.92	3.68	3.79½	4.28½
March	4.12	3.67	4.87	4.35	5.14	3.69	3.91½	4.32½
April	3.84	3.63	4.77	4.29	4.72½	3.64½	3.87½	4.20½
May	3.64	3.67	4.72	4.49	4.24	3.79½	4.13	4.25½
June	3.62	3.73	4.77	4.62	3.88	3.97½	4.37	4.41
July	3.58	4.06	4.88	4.50	3.96	3.88	4.43	....
August	3.58	4.25	4.75	4.55	4.43	3.82½	4.51	....
September	3.61	4.26	4.63	4.44	4.99	3.92½	4.86	....
October	3.69	4.10	4.28	4.30	4.45	3.82½	5.21½	....
November	3.46	4.12	4.32	4.35	3.67½	3.79	4.90	....
December	3.60	4.57	4.32	5.00	3.73	3.82	4.19	....
Yearly average	3.73½	3.94½	4.63	4.46½	4.41	3.80½	4.33½	....

The following table gives the highest and lowest prices monthly for a series of years:

Highest and lowest prices of lead at New York City, monthly, from 1870 to 1890, inclusive.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870	(a)6.30	6.20	6.25	6.17	6.20	6.10	6.25	6.15	6.25	6.20	6.25	6.20
1871	(a)6.30	6.15	6.25	6.20	6.20	6.15	6.20	6.10	6.18	6.10	6.15	6.12
1872	(a)6.00	5.90	6.00	5.87	6.00	5.87	6.12	5.90	6.62	6.25	6.62	6.40
1873	(a)6.37	6.25	6.50	6.40	6.50	6.25	6.50	6.25	6.62	6.35	6.55	6.12
1874	(a)6.00	5.90	6.25	6.00	6.25	6.12	6.25	5.90	6.00	5.75	6.00	5.62
1875	(a)6.20	6.00	5.90	5.85	5.75	5.62	5.87	5.80	5.95	5.90	5.90	5.75
1876	(a)6.00	5.87	6.37	6.00	6.50	6.40	6.40	6.12	6.50	6.10	6.50	6.25
1877	(b)6.15	6.12	6.40	6.20	6.75	6.50	6.50	6.25	6.00	5.55	5.70	5.60
1878	4.35	4.00	3.87	3.65	3.87	3.62	3.75	3.50	3.50	3.25	3.50	3.12
1879	4.50	4.00	4.50	4.50	4.50	3.25	3.25	2.87	3.12	2.87	3.80	3.12
1880	6.10	5.50	6.00	5.87	5.95	5.30	5.75	5.40	5.25	4.40	4.75	4.50
1881	5.00	4.30	5.10	4.80	4.85	4.62	4.85	4.37	4.70	4.25	4.50	4.25
1882	5.15	4.95	5.20	5.00	5.12	4.85	5.00	4.90	4.85	4.60	4.90	4.55
1883	4.70	4.60	4.60	4.50	4.65	4.50	4.62	4.40	4.55	4.40	4.45	4.40
1884	4.50	3.75	4.10	3.75	4.15	4.10	4.05	3.62½	3.75	3.52½	3.65	3.57½
1885	3.70	3.55	3.70	3.60	3.70	3.62½	3.70	3.62½	3.75	3.60	3.85	3.62½
1886	4.70	4.50	4.90	4.60	4.95	4.85	4.90	4.65	4.75	4.65	4.90	4.65
1887	4.45	4.15	4.50	4.25	4.45	4.25	4.32½	4.20	4.70	4.30	4.70	4.50
1888	4.90	4.50	5.15	4.60	5.25	5.00	5.05	4.55	4.62½	4.00	4.10	3.65
1889	3.90	3.75	3.75	3.60	3.75	3.65	3.67½	3.60	3.87½	3.60	4.05	3.90
1890	3.85	3.80	3.85	3.75	3.95	3.85	4.07½	3.85	4.35	4.00	4.50	4.25
1891	4.50	4.05	4.50	4.25	4.37½	4.25	4.32½	4.10	4.87½	4.20	4.50	4.85

a Gold. b Currency.

Highest and lowest prices of lead at New York City, etc.—Continued.

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870.....	6.30	6.20	6.37	6.32	6.37	6.30	6.37	6.25	6.35	6.25	6.35	6.25
1871.....	6.15	6.10	6.12	6.00	6.10	6.00	6.00	5.87	6.00	5.90	6.00	5.75
1872.....	6.62	6.40	6.50	6.40	6.50	6.30	6.62	6.40	6.60	6.50	6.60	6.42
1873.....	6.12	6.00	6.25	6.00	6.62	6.37	6.75	6.25	6.50	6.00	6.12	6.00
1874.....	5.80	5.62	5.80	5.65	6.10	5.65	6.35	6.10	6.50	6.25	6.40	6.12
1875.....	6.00	5.95	5.95	5.87	5.87	5.70	5.65	5.60	5.87	5.65	5.95	5.87
1876.....	6.35	6.20	6.37	6.25	6.25	6.00	6.00	5.80	5.80	5.70	5.70	5.65
1877.....	5.60	5.37	5.12	4.90	4.85	4.75	4.85	4.25	4.75	4.50	4.60	4.50
1878.....	3.62	3.25	3.50	3.20	3.45	3.25	3.60	3.37	3.95	3.60	4.00	3.90
1879.....	4.10	3.90	4.05	4.00	4.00	3.75	5.50	4.00	5.62	5.00	5.60	5.50
1880.....	4.75	4.25	5.00	4.30	4.90	4.80	4.87	4.65	4.85	4.75	4.75	4.25
1881.....	4.90	4.50	4.95	4.75	5.37	4.95	5.25	4.87	5.25	4.90	5.25	5.00
1882.....	5.15	4.90	5.10	4.95	5.15	4.95	5.15	4.85	4.90	4.50	4.75	4.50
1883.....	4.40	4.30	4.30	4.20	4.32	4.30	4.32	4.12	4.05	3.65	3.75	3.60
1884.....	3.70	3.55	3.70	3.52½	3.75	3.55	3.75	3.60	3.55	3.37½	3.75	3.50
1885.....	4.15	3.87½	4.25	4.12	4.25	4.00	4.25	4.00	4.60	4.00	4.67½	4.50
1886.....	4.90	4.75	4.80	4.75	4.70	4.45	4.30	4.00	4.40	4.10	4.35	4.25
1887.....	4.67½	4.40	4.62½	4.55	4.55	4.25	4.40	4.20	4.75	4.25	5.15	4.90
1888.....	4.07½	3.85	4.97½	4.15	5.12½	4.90	5.12½	3.62½	3.82½	3.60	3.82½	3.60
1889.....	4.05	3.80	3.95	3.75	4.00	3.85	3.90	3.75	3.90	3.75	3.90	3.75
1890.....	4.50	4.40	4.72½	4.35	5.00	4.67½	5.25	5.00	5.25	4.60	4.60	4.05

The following tables, compiled by Mr. E. A. Caswell, show the daily fluctuation in prices in 1889, 1890, and the first half of 1891:

Price of common pig lead in New York City in 1889.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1..........	H.	3.75	3.70	3.65	3.60	3.90	4.05	3.95	S.	3.85	3.75	S.
2..........	3.77½	3.75	3.72½	3.65	3.67½	S.	4.05	3.90	H.	3.85	3.75	3.75
3..........	3.85	S.	S.	3.65	3.67½	3.92½	4.00	3.85	3.97½	3.90	S.	3.75
4..........	3.90	3.75	3.65	3.65	3.80	3.97½	H.	S.	4.00	3.90	3.75	3.75
5..........	3.90	3.75	3.72½	3.65	S.	4.00	3.95	3.85	4.00	3.90	H.	3.75
6..........	S.	3.75	3.72½	3.65	3.87½	4.00	3.90	3.85	4.00	S.	3.85	3.75
7..........	3.85	3.75	3.72½	S.	3.87½	3.97½	S.	3.85	4.00	3.90	3.90	3.75
8..........	3.85	3.70	3.72½	3.65	3.87½	3.97½	3.90	3.85	S.	3.90	3.90	S.
9..........	3.85	3.70	3.72½	2.65	3.87½	S.	3.90	3.80	4.00	3.90	3.90	3.75
10..........	3.85	S.	S.	3.67½	3.87½	3.97½	3.90	3.75	3.95	3.90	S.	3.75
11..........	3.85	3.70	3.72½	3.67½	3.87½	3.97½	3.90	S.	3.95	3.85	3.90	3.75
12..........	3.85	3.65	3.72½	3.67½	S.	3.90	3.85	3.75	3.90	3.85	3.80	3.75
13..........	S.	3.65	3.72½	3.67½	3.87½	3.90	3.85	3.75	3.90	S.	3.80	3.87½
14..........	3,85	3.65	3.75	S.	3.87½	3.92½	S.	3.80	3.90	3.85	3.80	3.87½
15..........	3.85	3.60	3.70	3.65	3.87½	3.92½	3.85	3.80	S.	3.85	3.80	S.
16..........	3.85	3.60	3.70	3.65	3.87½	S.	3.85	3.80	3.90	3.85	3.75	3.87½
17..........	3.85	S.	S.	3.65	3.70	4.00	3.85	3.80	3.90	3.85	S.	3.90
18..........	3.85	3.65	3.70	3.65	3.70	4.00	3.85	S.	3.90	3.85	3.75	3.90
19..........	3.85	3.65	3.70	3.65	S.	4.00	3.80	3.80	3.90	3.80	3.75	3.90
20..........	S.	3.65	3.70	3.65	3.75	4.00	3.80	3.80	3.90	S.	3.75	3.90
21..........	3.85	3.65	3.65	S.	3.70	4.00	S.	3.80	3.90	3.80	3.75	3.87½
22..........	3.80	H.	3.65	3.62½	2.70	3.95	3.82½	3.80	S.	3.75	3.75	S.
23..........	3.80	3.65	3.65	3.62½	3.70	S.	3.80	3.80	3.90	3.75	3.75	3.85
24..........	3.75	S.	S.	3.65	3.70	4.00	3.80	3.80	3.90	3.75	S.	3.85
25..........	3.75	3.65	3.65	3.65	3.85	4.00	3.80	S.	3.90	3.75	3.75	H.
26..........	3.80	3·65	3.65	3.62½	S.	4.00	3.80	3.80	3.90	3.75	3.75	3.85
27..........	S.	3.65	3.65	3.60	3.85	4.00	3.80	3.80	3.90	S.	3.75	3.80
28..........	3.80	3.65	3.65	S.	3.85	4.00	S.	3.85	3.85	3.75	H.	3.85
29..........	3.75	....	3.65	3.60	3.85	4.05	3.80	3.85	S.	3.75	3.75	S.
30..........	3.75	....	3.65	H.	H.	S.	3.97½	3.90	3.85	3.75	3.75	3.85
31..........	3.75	....	S.	....	3.85	....	3.97½	3.90	....	3.75	....	3.85
Average.	3.82½	3.68	3.69	3.64½	3.79½	3.97½	3.88	3.82½	3.92½	3.82½	3.79	3.82

Price of common pig lead in New York City in 1890.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	H.	3.80	3.85	3.85	4.07½	S.	4.42½	4.40	H.	5.00	5.25	4.60
2	3.85	S.	S.	3.85	4.05	4.25	4.42½	4.35	4.67½	5.00	S.	4.60
3	3.85	3.80	3.85	3.85	4.00	4.25	4.42½	S.	4.75	5.00	5.25	4.60
4	3.85	3.80	3.85	H.	S.	4.25	H.	4.35	4.75	5.00	H.	4.55
5	S.	3.85	3.85	3.85	4.00	4.25	4.42½	4.35	4.75	S.	5.25	4.50
6	3.85	3.85	3.95	S.	4.00	4.25	S.	4.35	4.75	5.25	5.10	4.40
7	3.85	3.80	3.95	3.85	4.05	4.25	4.42½	4.35	S.	5.25	5.10	S.
8	3.85	3.80	3.95	3.85	4.05	S.	4.42½	4.35	4.75	5.25	5.10	4.30
9	3.85	S.	S.	3.85	4.05	4.32½	4.42½	4.35	4.75	5.25	S.	4.20
10	3.85	3.80	3.95	3.85	4.05	4.32½	4.42½	S.	4.75	5.25	5.10	4.15
11	3.80	3.80	3.95	3.85	S.	4.35	4.42½	4.35	4.75	5.25	5.10	4.15
12	S.	3.80	3.95	3.85	4.05	4.35	4.42½	4.35	4.75	S.	5.10	4.10
13	3.80	3.80	3.95	S.	4.05	4.35	S.	4.50	4.75	5.25	5.00	4.10
14	3.80	3.75	3.95	3.85	4.05	4.35	4.42½	4.50	S.	5.25	5.00	S.
15	3.80	3.75	3.95	3.85	4.10	S.	4.42½	4.50	4.75	5.25	5.00	4.10
16	3.80	S.	S.	3.85	4.10	4.35	4.50	4.50	4.75	5.25	S.	4.05
17	3.80	3.75	3.95	3.85	4.12½	4.35	4.50	S.	4.95	5.25	5.00	4.05
18	3.80	3.75	3.95	3.85	S.	4.45	4.45	4.62½	4.95	5.25	4.75	4.05
19	S.	3.75	3.95	3.85	4.15	4.45	4.45	4.62½	4.95	S.	4.75	4.05
20	3.80	3.75	3.95	S.	4.17½	4.50	S.	4.62½	5.00	5.25	4.65	4.05
21	3.80	3.75	3.95	3.85	4.35	4.50	4.45	4.62½	S.	5.25	4.65	S.
22	3.85	H.	3.90	3.90	4.80	S.	4.45	4.60	5.00	5.25	4.60	4.05
23	3.85	S.	S.	3.90	4.20	4.50	4.45	4.60	5.00	5.25	S.	4.05
24	3.80	3.75	3.90	3.90	4.20	4.45	4.40	S.	5.00	5.25	4.60	4.05
25	3.80	3.85	3.90	3.90	S.	4.42½	4.40	4.60	5.00	5.25	4.60	H.
26	S.	3.85	3.90	3.90	4.20	4.42½	4.40	4.72½	5.00	S.	4.60	4.05
27	3.80	3.85	3.90	S.	4.30	4.42½	S.	4.67½	5.00	5 25	H.	4.05
28	3.80	3.85	3.85	3.90	4.25	4.42½	4.40	4.67½	S.	5.25	4.60	S.
29	3.80	......	3.85	3.90	4.25	S.	4.40	4.67½	5.00	5.25	4.60	4.05
30	3.85	......	S.	4.07½	H.	4.42½	4.40	4.67½	5.00	5.25	S.	4.05
31	3.85	......	3.85	......	4.25	......	4.40	S.	......	5.25	......	4.05
Average	3.82½	3.79½	3.91½	3.87½	4.13	4.37	4.43	4.51	4.86	5.21½	4.90	4.19

Price of common pig lead in New York City during six months ending June 30, 1891.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	Days.	Jan.	Feb.	Mar.	Apr.	May.	June
1	H.	S.	S.	4.32½	4.20	4.42½	18	S.	4.25	4.30	4.15	4.20	4.35
2	4.05	4.35	4.25	4.32½	4.20	4.42½	19	4.50	4.25	4.30	S.	4.30	4.35
3	4.05	4.35	4.25	4.32½	S.	4.42½	20	4.40	4.25	4.30	4.10	4.25	4.35
4	S.	4.35	4.25	4.30	4.20	4.50	21	4.35	4.25	4.37½	4.10	4.25	S.
5	4.05	4.30	4.35	S.	4.20	4.50	22	4.30	S.	S.	4.12½	4.35	4.35
6	4.40	4.30	4.35	4.30	4.20	4.50	23	4.30	H.	4.35	4.12½	4.37½	4.35
7	4.40	4.50	4.35	4.32½	4.20	S.	24	4.25	4.25	4.35	4.12½	S.	4.40
8	4.40	S.	S.	4.30	4.20	4.45	25	S.	4.30	4.35	4.12½	4.37½	4.45
9	4.40	4.30	4.32½	4.25	4.20	4.40	26	4.25	4.25	4.35	S.	4.37½	4.50
10	4.40	4.30	4.32½	4.25	S.	4.40	27	4.25	4.25	4.35	4.12½	4.35	4.45
11	S.	4.25	4.32½	4.25	4.20	4.40	28	4.27½	4.25	4.35	4.20	4.35	S.
12	4.40	4.25	4.32½	S.	4.20	4.35	29	4.27½	......	S.	4.20	4.35	4.45
13	4.50	4.25	4.32½	4.25	4.20	4.35	30	4.37½	......	4.35	4.20	H.	4.45
14	4.50	4.25	4.32½	4.15	4.20	S.	31	4.35	......	4.32½	......	S.	......
15	4.50	S.	S.	4.15	4.20	4.35							
16	4.50	4.25	4.32½	4.15	4.20	4.35	Average	4.34½	4.28½	4.32½	4.20½	4.25½	4.41
17	4.50	4.25	4.30	4.15	S.	4.35							

Lead imported and entered for consumption in the United States, 1867 to 1890, inclusive.

[Calendar years ending December 31 from 1886 to 1890; previous years end June 30.]

Years.	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Lbs.		*Lbs.*		*Lbs.*		*Lbs.*			
1867...	611	$25	65, 322, 923	$2, 812, 668	185, 825	$9, 560			$6, 222	$2, 828, 475
1868...	6, 945	239	63, 254, 677	2, 668, 915	142, 137	7, 229			6, 604	2, 682, 987
1869...			87, 865, 471	3, 653, 481	307, 424	15, 531			18, 885	3, 687, 897
1870...	5, 973	176	85, 895, 724	3, 530, 837	141, 681	6, 879			10, 444	3, 548, 336
1871...	316	10	91, 496, 715	3, 721, 096	86, 712	4, 209			8, 730	3, 734, 045
1872...	32, 331	1, 425	73, 086, 657	2, 929, 623	15, 518	859			20, 191	2, 952, 098
1873...			72, 423, 641	3, 233, 011	105	12	420	$50	21, 503	3, 254, 576
1874...			46, 205, 154	2, 231, 817			30, 219	1, 349	36, 484	2, 269, 650
1875...	13, 206	320	82, 770, 712	1, 559, 017			58	4	25, 774	1, 585, 115
1876...			14, 329, 366	682, 132			20, 007	1, 204	27, 106	710, 442
1877...	1, 000	20	14, 583, 845	671, 482			16, 502	1, 242	1, 041	673, 785
1878...			6, 717, 052	294, 233			15, 829	963	113	295, 309
1879...			1, 216, 500	42, 983			3, 748	209	930	44, 122
1880...			6, 723, 706	246, 015			1, 120	54	371	246, 440
1881...	5, 981	97	4, 322, 068	159, 129			900	65	1, 443	160, 734
1882...	21, 698	500	6, 079, 304	202, 603			1, 469	99	2, 449	205, 651
1883...	600	17	4, 037, 867	130, 108			1, 510	79	8, 030	138, 234
1884...	419	13	3, 072, 738	85, 395	15, 040	630			1, 992	88, 030
1885...	4, 218	57	5, 862, 474	143, 103	971, 951	22, 217			1, 372	166, 749
1886...	715, 588	9, 699	17, 582, 298	491, 310	27, 357	1, 218			964	503, 191
1887...	153, 731	21, 487	7, 716, 783	219, 770	27, 941	1, 286			302	242, 845
1888...	88, 870	2, 468	2, 582, 236	69, 891	23, 103	1, 202			977	74, 538
1889...	328, 315	7, 468	2, 773, 622	76, 243	35, 859	1, 417			1, 297	86, 425
1890...	493, 463	12, 947	19, 336, 233	593, 671	68, 314	3, 338			1, 133	611, 089

Old and scrap lead imported and entered for consumption in the United States, 1867 to 1890, inclusive.

[Calendar years ending December 31 from 1886 to 1890; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	1, 255, 233	$53, 202	1879	42, 283	$1, 153
1868	2, 465, 575	101, 586	1880	213, 063	5, 262
1869	2, 983, 272	123, 068	1881	123, 018	2, 729
1870	3, 756, 785	150, 379	1882	220, 702	5, 949
1871	2, 289, 688	94, 467	1883	1, 094, 133	31, 724
1872	4, 257, 778	171, 324	1884	160, 356	4, 830
1873	3, 545, 098	151, 756	1885	4, 806	106
1874	395, 516	13, 897	1886	24, 726	882
1875	382, 150	13, 964	1887	136, 625	4, 323
1876	265, 860	9, 534	1888	33, 100	904
1877	249, 645	8, 383	1889	50, 816	1, 494
1878	106, 342	3, 756	1890	18, 246, 165	567, 304

Lead and manufactures of lead, of domestic production, exported from the United States.

Fiscal years ending September 30 until 1842, fiscal years ending June 30 until 1885, and calendar years ending December 31 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1790	13, 440	$810				$810
1803 (barrels)	900					
1804	19, 804					
1805	8, 000					
1808	40, 583					
1809	126, 537					
1810	172, 323					
1811	65, 497					
1812	74, 875					
1813	276, 940					

Lead and manufactures of lead, of domestic production, etc.—Continued.

Fiscal years ending September 30 until 1842, fiscal years ending June 30 until 1885, and calendar years ending December 31 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1814	43,600					
1815	40,245					
1816	35,844					
1817	111,034	$9,993				$9,993
1818	281,168	22,493				22,493
1819	94,362	7,549				7,549
1820	25,699	1,799				1,799
1821	56,192	3,512				3,512
1822	66,316	4,244				4,244
1823	51,549	3,098				3,098
1824	18,604	1,356				1,356
1825	189,930	12,697				12,697
1826	47,337	3,347	$1,820			5,167
1827	50,160	3,761	6,183			9,944
1828	76,882	4,184	5,545			9,729
1829	179,952	8,417	5,185			13,602
1830	128,417	4,831	4,172			9,003
1831	152,578	7,068	6,422			13,490
1832	72,439	4,483	983			5,466
1833	119,407	5,685	2,010			7,695
1834	13.480	805	2,224			3,029
1835	50,418	2,741	433			3,174
1836	34,600	2.218	4,777			6,995
1837	297,488	17,015	3,132			20,147
1838	375,231	21,747	6,461			28,208
1839	81,377	6,003	12,637			18,640
1840	882,620	39,687	15,296			54,983
1841	2,177,164	96,748	20,546			117,294
1842	14,552,357	523,428	16,789			540,217
1843 (nine months)	15,366,918	492,765	7,121			499,886
1844	18,420,407	595,238	10,018			605,256
1845	10,188,024	342,646	14,404			357,050
1846	16,823,766	614,518	10,278			624,796
1847	3,326,028	124,981	13,694			138,675
1848	1,994,704	84,278	7,739			92,017
1849	680,249	30,198	13,196			43,394
1850	261,123	12,797	22,682			35,479
1851			16,426	229,448	$11,774	28,200
1852			18,469	747,930	32,725	51,194
1853			14,064	100,778	5,540	19,604
1854			16,478	404,247	26,874	43,352
1855			5,233	165,533	14,298	19,531
1856			5,628	310,029	27,512	33,140
1857			4,818	870,544	58,624	63,442
1858			27,327	900,607	48,119	75,446
1859			28,782	313,988	28,575	57,357
1860			56,081	903,468	50,446	106,527
1861			30,534	109,023	6,241	36,775
1862			28,832	79,231	7,334	36,166
1863			30,609	237,239	22,634	53,243
1864			30,411	223,752	18,718	49,129
1865			29,271	852,895	132,666	161,937
1866			44,483	25,278	2,323	46,806
1867			27,559	99,158	5.300	32,859
1868			37,111	438,040	34,218	71,329
1869			17,249			17,249
1870		28,315				28,315
1871		79,880				79,880
1872		48,132				48,132
1873		13,392				13,392
1874		302,044				302,044
1875		429,309				429,309
1876		102,726				102,726
1877		49,835				49,835
1878		314,904				314,904
1879		280,771				280,771
1880		49,809				49,899
1881		39,710				39,710
1882		178,779				178,779
1883		43,108				43,108
1884		135,156				135,156
1885		123,466				123,466
1886		136,666				136,666
1887		140,065				140,065
1888		194,216				194,216
1889		161,614				161,614
1890		181,030				181,030

ZINC.

BY C. KIRCHHOFF.

During the years 1889 and 1890 the zinc industry of the United States showed steady progress, the development in the production taking place particularly, however, in the West. The census report, which covered the calendar year 1889, for the first time revealed many facts relating to the industry which are of special interest. The production of zinc ore in the leading States and counties was as follows:

Production of zinc ore in the leading States in 1889.

States and counties.	Quantity.	Value.
Wisconsin:	*Short tons.*	
Iowa county	16,996	$237,463
Lafayette county	7,132	152,973
Grant county	703	10,132
Total Wisconsin	24,831	400,568
Missouri:		
Barry county	180	2,340
Dade county	153	1,308
Greene county	677	17,139
Jasper county	72,026	1,629,538
Lawrence county	9,463	158,665
Morgan county	15	480
Newton county	8,307	191,487
Missouri—continued.		
St. Francois county	*Short tons.* 2,310	$23,100
Total Missouri	93,131	2,024,057
Iowa	450	3,600
Kansas	39,575	299,192
Arkansas	130	3,250
Eastern States	63,339	175,052
Southern States	12,906	141,560
New Mexico	140	2,520
Total United States	234,502	3,049,799

It should be noted that a large part of the product credited to Kansas was crude, undressed ore, which makes its tonnage large, while the value is low.

The following is a summary of the census statistics relating to the spelter and zinc-oxide works of the United States:

Census statistics of spelter and zinc oxide.

Product:	
Spelter . . . . short tons	58,860
Zinc oxide . . . . do.	16,970
Stock:	
Spelter, January 1, 1889, short tons	2,781
Spelter, January 1, 1890, short tons	2,492
Zinc oxide, January 1, 1889, short tons	1,425
Zinc oxide, January 1, 1890, short tons	1,261
Ore treated . . . . short tons	196,309
Value of ore treated	$4,154,403.98
Labor:	
Foremen	82
Mechanics	457
Laborers	2,024
Boys	127
Total wages	$1,424,980.52
Office force	95
Salaries	$140,279.91
Expenses:	
Contractors	$15;318.84
Supplies	$653,305.75
All other	$210,913.39

No direct deductions as to cost can be drawn from these figures, because they deal with two industries, which in some parts of the country are so closely associated that they are not separated in accounts and in other parts, notably in the West, are sharply separated. The outlays incidental to the rolling of 9,389 short tons of sheet zinc are also included. Reports from all the works in the United States show that the production of spelter has been as follows:

Production of spelter in the United States.

Years.	Short tons.	Years.	Short tons.
1873	7,343	1885	40,688
1875	15,833	1886	42,641
1880 (Census year ending May 31).	23,239	1887	50,340
		1888	55,903
1882	33,765	1889	58,860
1883	36,872	1890	63,683
1884	38,544		

Grouped by States, the product has been as follows:

Production of spelter in the United States, 1882 to 1890, inclusive, by States.

States.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	18,201	16,792	17,594	19,427	21,077	22,279	22,445	23,860	26,243
Kansas	7,366	9,010	7,859	8,502	8,932	11,955	10,432	13,658	15,199
Missouri	2,500	5,730	5,230	4,677	5,870	8,660	13,465	11,077	13,127
Eastern and Southern States	5,698	5,340	7,861	8,082	6,762	7,446	9,561	10,265	9,114
Total	33,765	36,872	38,544	40,688	42,641	50,340	55,903	58,860	63,683

For the first time complete returns of stocks on hand have been rereceived. The following are the aggregates:

Stocks of spelter.

States.	January 1—		
	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*
Illinois	360	268	68
Kansas	800	1,075	233
Missouri	......	43	45
East and South	1,621	1,149	788
Total	2,781	2,535	1,134

The stock in the hands of producers is therefore small, considering the magnitude of the industry. The apparent consumption of domestic spelter increased, therefore, from 59,434 tons in 1889, to 69,084 tons in 1890.

Zinc imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Blocks or pigs.		Sheets.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	5, 752, 611	$256, 366	5, 142, 417	$311, 767	$1, 835	$569, 968
1868	9, 327, 968	417, 273	3, 557, 448	203, 883	1, 623	622, 779
1869	13, 211, 575	590, 332	8, 306, 723	478, 646	2, 083	1, 071, 061
1870	9, 221, 121	415, 497	9, 542, 687	509, 860	21, 696	947, 053
1871	11, 159, 040	508, 355	7, 646, 821	409, 243	26, 366	943, 964
1872	11, 802, 247	522, 524	10, 704, 944	593, 885	58, 668	1, 175, 077
1873	6, 839, 897	331, 399	11, 122, 143	715, 706	56, 813	1, 103, 918
1874	3, 593, 570	203, 479	6, 016, 835	424, 504	48, 304	676, 287
1875	2, 034, 252	101, 766	7, 320, 713	444, 539	26, 330	572, 635
1876	947, 322	56, 082	4, 611, 360	298, 308	18, 427	372, 817
1877	1, 266, 894	63, 250	1, 341, 833	81, 815	2, 496	147, 561
1878	1, 270, 184	57, 753	1, 255, 620	69, 381	4, 892	132, 026
1879	1, 419, 791	53, 294	1, 111, 225	53, 050	3, 374	109, 718
1880	8, 092, 620	371, 920	4, 069, 310	210, 230	3, 571	585, 721
1881	2, 859, 216	125, 457	2, 727, 324	129, 158	7, 603	262, 218
1882	18, 408, 391	736, 964	4, 418, 042	207, 032	4, 940	948, 936
1883	17, 067, 211	655, 503	3, 309, 239	141, 823	5, 606	802, 932
1884	5, 869, 738	208, 852	952, 253	36, 120	4, 795	249, 767
1885	3, 515, 840	113, 268	1, 839, 860	64, 781	2, 054	180, 103
1886	4, 300, 830	136, 138	1, 092, 400	40, 320	9, 162	185, 620
1887	8, 387, 647	276, 122	926, 150	32, 526	11, 329	319, 977
1888	3, 825, 947	146, 156	295, 287	12, 558	12, 080	170, 794
1889	2, 052, 559	77, 845	1, 014, 873	43, 356	19, 580	140, 781
1890	1, 997, 524	101, 335	781, 266	43, 495	9, 740	154, 570

Imports of zinc oxide in 1885, 1886, 1887, 1888, 1889, and 1890.

Calendar years ending December 31, from 1886 to 1890; previous year ends June 30.	Dry.	In oil.
	Pounds.	*Pounds.*
1885	2, 233, 128	98, 566
1886	2, 526, 389	79, 788
1887	4, 961, 080	123, 216
1888	1, 401, 342	51, 985
1889	2, 686, 861	66, 240
1890	2, 631, 458	102, 298

Exports of zinc and zinc ore of domestic production, 1864 to 1890, inclusive.

Calendar years ending December 31, from 1886 to 1890· previous years end June 30.	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwt.		*Pounds.*			
1864	14, 810	$116, 431	95, 738	$12, 269	....	$128, 700
1865	99, 371	114, 149	184, 183	22, 740	....	136, 889
1866	4, 485	25, 091	140, 798	13, 290	....	38, 381
1867	3, 676	32, 041	312, 227	30, 587	....	62, 628
1868	8, 344	74, 706	1, 022, 699	68, 214	....	142, 920
1869	....	65, 411	....	....	....	65, 411
1870	15, 286	81, 487	110, 157	10, 672	....	92, 159
1871	9, 621	48, 292	76, 380	7, 823	....	56, 115
1872	3, 686	20, 880	62, 919	5, 726	....	26, 606
1873	234	2, 304	73, 953	4, 656	....	6, 960
1874	2, 550	20, 037	43, 566	3, 612	....	23, 649
1875	8, 083	20, 659	38, 090	4, 245	$1, 000	25, 904
1876	10, 178	66, 259	134, 542	11, 651	4, 333	82, 243
1877	6, 428	34, 468	1, 419, 922	115, 122	1, 118	150, 708
1878	16, 050	83, 831	2, 545, 320	216, 580	567	300, 978
1879	10, 660	40, 399	2, 132, 949	170, 654	....	211, 053
1880	13, 024	42, 036	1, 368, 302	119, 264	....	161, 300
1881	11, 390	16, 405	1, 491, 786	132, 805	168	149, 378
1882	10, 904	13, 736	1, 489, 552	124, 638	....	138, 374
1883	3, 045	11, 509	852, 333	70, 981	734	83, 224
1884	4, 780	16, 685	126, 043	9, 576	4, 666	30, 927
1885	6, 840	22, 824	101, 685	7, 270	4, 991	35, 085
1886	26, 620	49, 455	917, 229	75, 192	13, 526	138, 173
1887	4, 700	17, 286	136, 670	9, 017	16, 789	43, 092
1888	4, 560	18, 034	62, 234	4, 270	19, 098	41, 402
1889	26, 760	73, 802	879, 785	44, 049	35, 732	153, 583
1890	77, 360	195, 113	3, 295, 584	126, 291	23, 587	344, 991

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875 to 1890, inclusive.

[Cents per pound. Figures in parentheses are combination prices.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	6.75	6.37	6.67	6.25	6.50	6.20	(7.00)	6.50	(7.25)	7.15	(7.25)	7.15
1876	(7.60)	7.40	(7.75)	7.50	(7.75)	7.62	(8.00)	7.60	(8.00)	7.75	(8.00)	7.25
1877	6.50	6.25	6.62	6.50	6.50	6.37	6.37	6.25	6.25	6.00	6.12	5.87
1878	5.75	5.50	5.62	5.25	5.62	5.25	5.25	5.00	5.00	4.62	4.62	4.25
1879	4.50	4.25	4.62	4.40	4.62	4.37	4.75	4.25	4.50	4.25	4.37	4.12
1880	6.50	5.87	6.75	6.37	6.75	6.50	6.50	6.12	6.00	5.62	5.50	5.12
1881	5.25	4.87	5.25	5.12	5.00	4.87	5.12	4.75	5.00	4.87	5.00	4.75
1882	6.00	5.75	5.75	5.62	5.62	5.37	5.50	5.25	5.62	5.25	5.37	5.25
1883	4.62	4.50	4.62	4.50	4.75	4.62	4.75	4.60	4.75	4.50	4.62	4.37
1884	4.37	4.20	4.40	4.25	4.60	4.40	4.65	4.50	4.60	4.45	4.60	4.45
1885	4.50	4.12	4.30	4.25	4.30	4.12	4.30	4.12	4.25	4.10	4.10	4.00
1886	4.50	4.30	4.55	4.30	4.60	4.50	4.60	4.50	4.60	4.40	4.40	4.35
1887	4.60	4.50	4.60	4.40	4.60	4.40	4.65	4.45	4.65	4.45	4.65	4.50
1888	5.37	5.20	5.35	5.25	5.25	4.87	4.87	4.60	4.65	4.60	4.60	4.50
1889	5.00	5.00	5.00	4.90	4.87	4.70	4.65	4.65	4.85	4.62	5.00	5.00
1890	5.45	5.35	5.35	5.20	5.20	5.00	5.00	4.90	5.45	5.00	5.60	5.35

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	(7.35)	7.25	(7.25)	7.10	(7.25)	7.10	(7.40)	7.15	(7.40)	7.15	(7.40)	7.15
1876	7.25	7.12	7.25	7.00	7.12	6.80	6.75	6.62	6.62	6.37	6.50	6.37
1877	5.87	5.62	5.90	5.80	5.87	5.75	5.90	5.70	5.87	5.62	5.75	5.50
1878	4.75	4.50	4.87	4.50	4.87	4.75	4.82	4.50	4.75	4.50	4.37	4.25
1879	4.75	4.37	5.62	4.80	6.00	5.62	6.37	6.00	6.25	5.87	6.25	6.00
1880	5.00	4.87	5.25	4.87	5.12	4.75	5.00	4.87	4.90	4.65	4.75	4.65
1881	5.00	4.75	5.12	5.00	5.25	5.00	5.37	5.25	5.87	5.50	6.00	5.87
1882	5.37	5.12	5.50	5.12	5.37	5.12	5.37	5.12	5.12	4.87	4.87	4.50
1883	4.50	4.30	4.40	4.30	4.50	4.40	4.45	4.35	4.40	4.37	4.37	4.35
1884	4.55	4.45	4.62	4.52	4.62	4.50	4.55	4.40	4.40	4.30	4.25	4.00
1885	4.40	4.10	4.60	4.40	4.62	4.50	4.62	4.50	4.60	4.45	4.60	4.45
1886	4.40	4.30	4.40	4.30	4.40	4.25	4.30	4.25	4.30	4.25	4.50	4.35
1887	4.50	4.50	4.60	4.55	4.65	4.60	4.65	4.50	4.80	4.52	5.87	5.00
1888	4.55	4.50	4.87	4.50	5.12	4.75	5.12	4.87	5.12	4.87	5.12	4.87
1889	5.10	5.00	5.20	5.15	5.15	5.10	5.15	5.10	5.25	5.05	5.35	5.30
1890	5.60	5.40	5.55	5.40	5.65	5.50	6.00	5.65	6.10	5.90	6.00	5.90

Opening the year 1890 with a steady market at 5.45 cents, a moderate business and freer offerings led to a decline to 5.35 cents, New York, toward the close of January. The falling market and general dullness continued during February and March, 5 cents being reached in that month. Good western spelter sold as low as 4.90 cents, New York, in April, but toward the close of that month developed a better feeling, rising to 5 cents. May brought a much better demand, and simultaneously a scarcity of ores told on the market, which went up to 5.45 cents. The rapid rise brought out some realizing to take profits on the part of second hands, which temporarily depressed the price to 5.35 cents in June, but when once these lots were disposed of the market rose to 5.60

cents under considerable purchases for consumption. The metal was steady during July and August, fluctuating in price between 5.40 cents and 5.55 cents as the extremes. The large consumption by brass-makers and galvanizers, and the general buoyancy of the whole metal trade, brought spelter up to 5.65 cents in September, and to 6.10 cents in October. The November financial troubles had their effect upon the market, as they did in all other metals, but in a much less marked degree, the price holding up to 5.90 cents toward the close of November and during December.

Messrs. Henry R. Merton & Co., of London, make the following report on the spelter production of Europe:

Estimate of the production of zinc in Europe.

Countries.	1890.	1889.	1888.	1887.	1886.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	137,630	134,648	133,245	130,995	129,020	129,754
Silesia	87,475	85,483	83,375	81,375	81,630	79,623
Great Britain	29,145	30,806	26,783	19,339	20,730	24,299
France and Spain	18,240	16,785	16,140	16,028	15,305	14,847
Poland	3,620	3,026	3,785	3,580	4,145	5,019
Austria	7,135	6,330	4,977	5,338	5,000	5,610
Total Europe	283,245	277,078	268,305	256,655	255,830	259,152

Countries.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	129,240	123,891	119,193	110,989	98,830
Silesia	76,116	70,405	68,811	66,497	64,459
Great Britain	29,259	28,661	25,581	24,419	(*a*) 22,000
France and Spain	15,341	14,671	18,075	(*a*) 18,358	15,000
Poland	4,164	3,733	4,400	(*a*) 4,000	(*a*) 4,000
Austria	6,170	6,267	6,709	5,825	5,970
Total Europe	260,290	247,628	242,769	230,088	210,259

a Estimated.

The output of the works in the different districts was as follows:

Production of zinc by principal foreign producers.

Districts.	1890.	1889.	1888.	1887.	1886.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium:						
Vieille Montagne	52,865	52,016	51,670	51,517	50,790	50,687
Stolberg Co	14,855	14,634	14,036	14,070	14,065	14,452
Austro-Belge	9,250	9,245	9,140	9,280	9,130	9,610
G. Dumont & Frères	8,350	8,863	8,759	8,368	8,000	7,072
Rhein-Nassau Co	7,960	7,470	7,586	7,588	7,730	7,676
L. de Laminne	6,760	6,693	6,597	6,745	6,550	7,039
Escombrera Bleyberg	5,630	5,560	4,930	4,925	5,315	5,835
Grillo	5,490	5,353	5,299	5,100	5,075	5,158
Märk, Westf., Bergw., Ver	5,485	5,805	5,537	5,553	4,950	4,429
Nouvelle Montagne	5,350	5,090	5,032	4,975	4,995	5,079
Berzelius	5,175	4,910	4,818	4,890	4,985	5,046
Eschger Ghesquière & Co	4,065	4,303	4,137	4,079	3,710	3,792
Société Prayon	4,100	3,956	3,906	3,905	3,725	3,879
Société de Boom	2,295	*a*750	1,798	....	....	....
	137,630	134,648	133,245	130,995	129,020	129,754
Silesia:						
Schlesische Actien-Gesellschaft	24,840	23,675	22,917	22,680	22,730	21,750
G. von Giesche's Erben	18,550	18,206	17,594	17,600	17,505	16,782
Herzog von Ujest	16,355	16,202	15,456	15,835	15,610	15,595
Graf H. Henckel von Donnersmarck	11,670	11,392	11,193	11,565	9,355	9,680
Graefin Schaffgotsch	6,265	6,405	6,402	6,430	6,505	6,091
Graf G. Henckel von Donnersmarck	4,090	3,943	4,114	1,565	1,670	1,682
Graf Lasy Henckel von Donnersmarck (included in Graf H. Henckel v. D.)	....	....	....	....	2,450	2,165
H. Roth	1,750	1,660	1,555	1,670	1,675	1,733
Wünsch	1,880	1,907	1,906	1,885	1,860	1,858
Vereinigte Königs & Laurahütte	1,020	1,130	1,166	1,065	1,185	1,305
Baron v. Horschitz'sche Erben	830	963	935	910	915	876
Fiscus	225	170	137	170	170	106
	87,475	85,653	83,375	81,375	81,630	79,623
Great Britain:						
Vivian & Sons	6,605	6,842	6,510	4,840	7,389	8,048
English Crown Spelter Co. (Limited)	4,945	4,981	4,980	4,007	3,248	3,500
Dillwyn & Co	3,930	4,540	3,904	2,843	3,015	2,967
Swansea Vale Spelter Co	1,615	2,161	2,150	1,798	2,060	2,185
Villiers Spelter Co	1,890	2,180	1,993	1,810	1,880	1,985
Pascoe, Grenfell & Sons	1,160	1,272	1,330	1,124	727	1,082
Nenthead & Tynedale Co	1,530	1,507	1,516	1,317	1,193	1,380
John Lysaght (Limited)	4,450	5,113	3,750	1,600	1,218	1,952
Staffordshire Knot	350	1,100	150	....	....	700
Minera Mines	2,170	610	....	....	....	....
H. Kenyon & Co	500	500	500	500	500	500
	29,145	30,806	26,783	19,839	21,230	24,299
France and Spain:						
Asturienne	18,240	16,785	16,140	16,028	15,305	14,847
Austria:						
Sagor	1,430	1,210	1,087	866	1,000	970
Cilli	1,880	1,679	1,240	1,272	1,360	1,440
Siersza-Niedzieliska	3,825	3,450	2,650	3,200	2,640	3,200
	7,135	6,330	4,977	5,338	5,000	5,610
Poland	3,620	3,026	*a*3,785	3,580	4,145	5,019

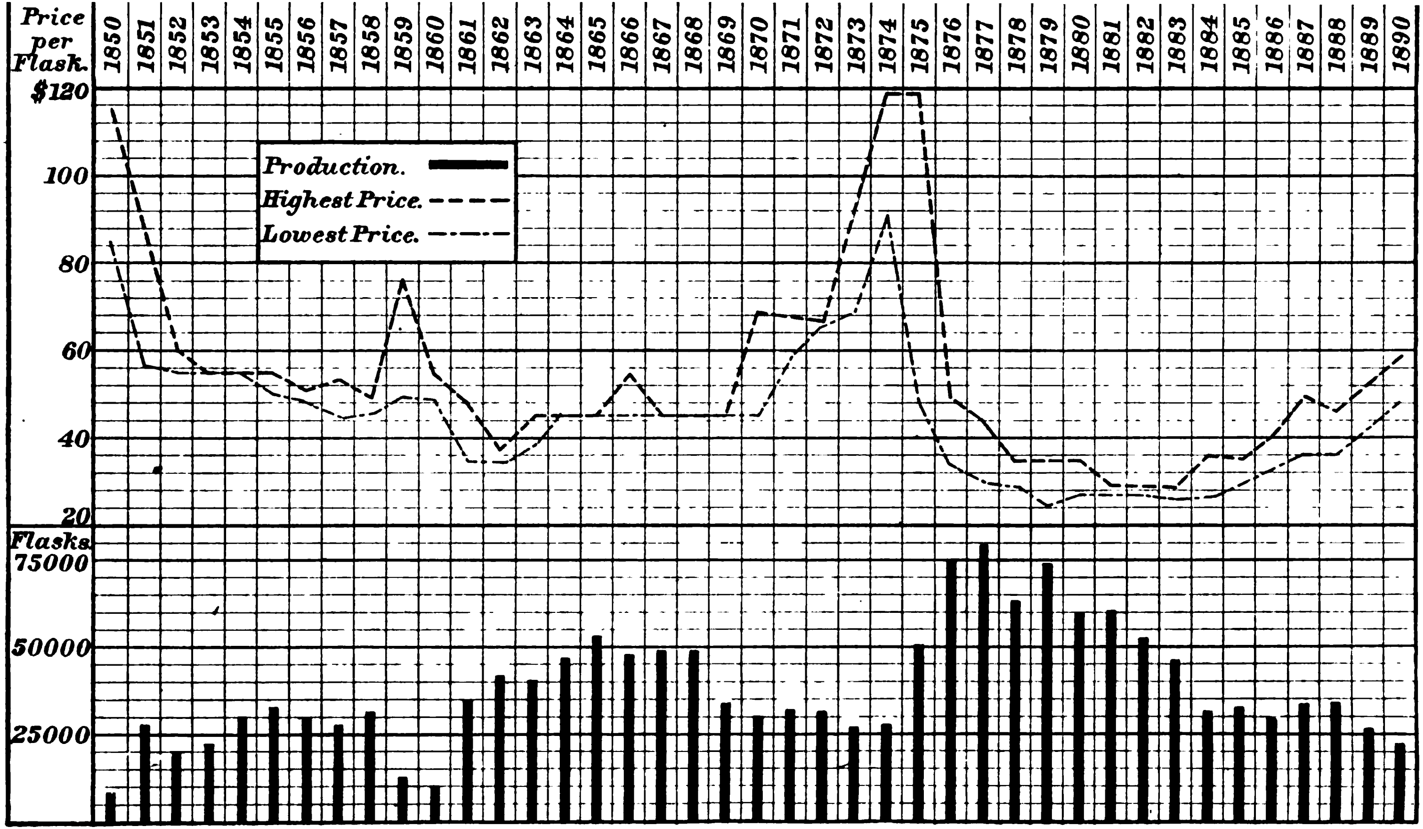
a Estimated.

QUICKSILVER.

The quicksilver mines in California are becoming exhausted. The decline in production noted in 1888 continued in 1889 and 1890. The total product in 1888 was 33,250 flasks, in 1889, 26,484 flasks, including 20 flasks from Oregon, and in 1890, 22,926 flasks. The price per flask in 1888 ranged from $36 to $47; in 1889 the range was from $40 to $50, and in 1890 it increased to from $47 to $58 per flask. Using the averages of these figures the total value for 1890, $1,203,615, is slightly greater than in 1889, and for a smaller amount of mining and smelting. The percentage yield of the ores decreased slightly, but not in proportion to the increased price. The above information, together with the table of production by mines, has been obtained from Mr. James B. Randol, of San Francisco. The information for 1889 was collected by him and published by the Census Office.

The product for 1889 includes 20 flasks from Oregon, but no product is reported from any State except California in 1890.

No new deposits have been found in the United States, although active search has been made, and many finds reported to be valuable have been carefully investigated in vain. Usually these finds have been clays stained with oxides of iron and bearing no resemblance to cinnabar, while in Arizona genuine ore was found, but of too poor quality to work even at high prices.



PRODUCTION AND PRICE OF QUICKSILVER IN THE UNITED STATES.

To face page 94.

Production of quicksilver in the United States to the close of 1890. (Flasks of 76½ pounds.)

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Pope Valley.	Napa Consolidated. (a).	St. John.	Altoona.	Oceanic.	Oakland.	California.	Great Eastern.	Sunderland.	Cloverdale.	Abbott.	Bradford.	Various mines.	Total yearly production of California mines.
1850....	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.	......	......	Yearly production previous to 1875 not obtainable (estimated at 20,000 flasks), included in production of various mines.	......	......	......	......	Some was produced prior to 1875, but no record kept (estimated production previous to 1875, 1,000 flasks), included in production of various mines.	......	......	......	......	......	......	......	......	......	7,723
1851....	27,779		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	27,779
1852....	15,901		......	......		......	......	......	......		......	......	......	......	......	......	......	......	4,099	20,000
1853....	22,284		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	22,284
1854....	30,004		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	30,004
1855....	29,142		......	......		......	......	......	......		......	......	......	......	......	......	......	......	3,858	33,000
1856....	27,138		......	......		......	......	......	......		......	......	......	......	......	......	......	......	2,862	30,000
1857....	28,204		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	28,204
1858....	25,761		......	......		......	......	......	......		......	......	......	......	......	......	......	......	5,239	31,000
1859....	1,294		......	......		......	......	......	......		......	......	......	......	......	......	......	......	11,706	13,000
1860....	7,061		......	......		......	......	......	......		......	......	......	......	......	......	......	......	2,939	10,000
1861....	34,429		......	......		......	......	......	......		......	......	......	......	......	......	......	......	571	35,000
1862....	39,671		444	......		......	......	......	......		......	......	......	......	......	......	......	......	1,885	42,000
1863....	32,803		852	......		......	......	......	......		......	......	......	......	......	......	......	......	6,876	40,531
1864....	42,489		1,914	......		......	800	......	......		......	......	......	......	......	......	......	......	2,286	47,489
1865....	47,194		3,545	......		......	......	......	......		......	......	......	......	......	......	......	......	2,261	53,000
1866....	35,150	6,525	2,254	......		......	......	......	......		......	......	......	......	......	......	......	......	2,621	46,550
1867....	24,461	11,493	7,862	......		......	......	......	......		......	......	......	......	......	......	......	......	3,184	47,000
1868....	25,628	12,180	8,686	......		......	1,122	......	......		......	......	......	......	......	......	......	......	112	47,728
1869....	16,898	10,315	5,018	......		......	1,580	......	......		......	......	......	......	......	......	......	......	......	33,811
1870....	14,423	9,888	4,546	......		......	1,220	......	......		......	......	......	......	......	......	......	......	......	30,077
1871....	18,568	8,180	2,128	......		......	1,970	......	......		......	......	......	......	......	......	......	......	840	31,686
1872....	18,574	8,171	3,046	......		......	1,830	......	......		......	......	......	......	......	......	......	......	......	31,621
1873....	11,042	7,735	3,294	......		340	1,955	......	......		......	......	......	......	......	......	......	......	3,276	27,642
1874....	9,084	6,911	6,678	573		1,122	1,645	......	1,743		......	......	......	......	......	......	......	......	......	27,756
1875....	13,648	8,432	7,513	5,372	3,342	3,384	1,940	......	1,927	533	......	......	......	412	......	......	......	......	3,747	50,250
1876....	20,549	7,272	9,183	8,367	7,381	4,322	300	573	1,683	1,979	2,358	2,150	965	387	1,570	1,028	1,436	......	2,595	75,074
1877....	23,996	6,316	9,399	10,993	6,241	5,856	1,060	2,229	1,463	1,317	2,575	1,395	1,516	505	735	1,291	836	......	1,234	79,396
1878....	15,852	5,138	6,686	9,465	9,072	4,963	1,075	3,049	......	1,534	1,679	1,615	1,640	1,366	472	116	......	......	158	63,880
1879....	20,514	4,425	4,516	9,249	15,540	6,333	1,325	3,605	1,290	1,919	779	1,505	1,110	1,455	......	18	......	......	101	73,684
1880....	23,465	3,209	2,139	10,706	6,670	6,442	275	4,416	492	245	......	166	422	1,279	......	......	......	......	......	59,926
1881....	26,060	2,775	2,194	11,152	5,228	6,241	......	5,552	......	......	......	......	......	1,065	......	208	......	......	376	60,851
1882....	28,070	1,953	2,171	5,014	1,138	5,179	......	6,842	......	......	......	......	......	2,124	......	......	......	......	241	52,732
1883....	29,000	1,606	1,894	2,612	84	3,869	......	5,890	......	......	......	......	......	1,669	......	......	......	......	101	46,725
1884....	20,000	1,025	881	890	1,179	3,292	......	4,307	......	......	......	......	......	332	......	......	......	......	7	31,913
1885....	21,400	1,144	385	1,296	35	3,469	......	3,506	......	......	......	......	......	446	......	......	......	......	392	32,073
1886....	18,000	1,406	409	1,449	......	1,949	......	5,247	......	......	......	......	......	735	......	......	......	......	786	29,981
1887....	20,000	1,890	673	1,490	......	1,446	......	5,574	......	......	......	......	......	689	......	......	......	1,543	(b) 692	33,997
1888....	18,000	1,320	126	2,164	......	625	......	5,024	......	......	......	......	......	1,151	......	......	......	3,848	992	33,250
1889....	13,100	980	812	2,283	......	556	......	4,590	......	......	......	......	......	1,345	......	......	......	1,874	(c) 944	26,484
1890....	12,000	977	505	1,608	......	1,334	......	3,429	......	......	......	......	......	1,046	......	......	......	1,290	737	22,926
Total..	916,359	131,266	99,753	84,683	55,910	60,722	18,097	63,833	8,598	7,527	7,391	6,831	5,653	16,006	2,777	2,661	2,272	8,555	68,961	1,567,855

Production of quicksilver in the United States to the close of 1890. (Flasks of 76½ pounds.)

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Pope Valley.	Napa Consolidated. (a).	St. John.	Altoona.	Oceanic.	Oakland.	California.	Great Eastern.	Sunderland.	Cloverdale.	Abbott.	Bradford.	Various mines.	Total yearly production of California mines.
1850....	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.	......	......	Yearly production previous to 1875 not obtainable (estimated at 20,000 flasks), included in production of various mines.	......	......	......	......	Some was produced prior to 1875, but no record kept (estimated production previous to 1875, 1,000 flasks), included in production of various mines.	......	......	......	......	......	......	......	......	......	7,723
1851....	27,779		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	27,779
1852....	15,901		......	......		......	......	......	......		......	......	......	......	......	......	......	......	4,099	20,000
1853....	22,284		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	22,284
1854....	30,004		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	30,004
1855....	29,142		......	......		......	......	......	......		......	......	......	......	......	......	......	......	3,858	33,000
1856....	27,138		......	......		......	......	......	......		......	......	......	......	......	......	......	......	2,862	30,000
1857....	28,204		......	......		......	......	......	......		......	......	......	......	......	......	......	......	......	28,204
1858....	25,761		......	......		......	......	......	......		......	......	......	......	......	......	......	......	5,239	31,000
1859....	1,294		......	......		......	......	......	......		......	......	......	......	......	......	......	......	11,706	13,000
1860....	7,061		......	......		......	......	......	......		......	......	......	......	......	......	......	......	2,939	10,000
1861....	34,429		......	......		......	......	......	......		......	......	......	......	......	......	......	......	571	35,000
1862....	39,671		444	......		......	......	......	......		......	......	......	......	......	......	......	......	1,885	42,000
1863....	32,803		852	......		......	......	......	......		......	......	......	......	......	......	......	......	6,876	40,531
1864....	42,489		1,914	......		......	800	......	......		......	......	......	......	......	......	......	......	2,286	47,489
1865....	47,194		3,545	......		......	......	......	......		......	......	......	......	......	......	......	......	2,261	53,000
1866....	35,150	6,525	2,254	......		......	......	......	......		......	......	......	......	......	......	......	......	2,621	46,550
1867....	24,461	11,493	7,862	......		......	......	......	......		......	......	......	......	......	......	......	......	3,184	47,000
1868....	25,628	12,180	8,686	......		......	1,122	......	......		......	......	......	......	......	......	......	......	112	47,728
1869....	16,898	10,315	5,018	......		......	1,580	......	......		......	......	......	......	......	......	......	......	......	33,811
1870....	14,423	9,888	4,546	......		......	1.220	......	......		......	......	......	......	......	......	......	......	......	30,077
1871....	18,568	8,180	2,128	......		......	1,970	......	......		......	......	......	......	......	......	......	......	840	31,686
1872....	18,574	8,171	3,046	......		......	1,830	......	......		......	......	......	......	......	......	......	......	......	31,621
1873....	11,042	7,735	3,294	......		340	1,955	......	......		......	......	......	......	......	......	......	......	3,276	27,642
1874....	9,084	6,911	6,678	573		1,122	1,645	......	1,743		......	......	......	......	......	......	......	......	......	27,756
1875....	13,648	8,432	7,513	5,372	3,342	3,384	1,940	......	1,927	533	......	......	......	412	......	......	......	......	3,747	50,250
1876....	20,549	7,272	9,183	8,367	7,381	4,322	300	573	1,683	1,979	2,358	2,150	965	387	1,570	1,028	1,436	......	2,595	75,074
1877....	23,996	6,316	9,399	10,993	6,241	5.856	1,060	2,229	1,463	1,317	2,575	1,395	1,516	505	735	1,291	836	......	1,234	79,396
1878....	15,852	5,138	6,686	9,465	9,072	4,963	1,075	3,049	......	1,534	1,679	1,615	1,640	1,366	472	116	......	......	158	63,880
1879....	20,514	4,425	4,516	9,249	15,540	6,333	1,325	3,605	1,290	1,919	779	1,505	1,110	1,455	......	18	......	......	101	73,684
1880....	23,465	3,209	2,139	10,706	6,670	6,442	275	4,416	492	245	......	166	422	1,279	......	......	......	......	......	59,926
1881....	26,060	2,775	2,194	11,152	5,228	6,241	......	5,552	......	......	......	......	......	1,065	......	208	......	......	376	60,851
1882....	28,070	1,953	2,171	5,014	1,138	5,179	......	6,842	......	......	......	......	......	2,124	......	......	......	......	241	52,732
1883....	29,000	1,606	1,894	2,612	84	3.869	......	5,890	......	......	......	......	......	1,669	......	......	......	......	101	46,725
1884....	20,000	1,025	881	890	1,179	3,292	......	4,307	......	......	......	......	......	332	......	......	......	......	7	31,913
1885....	21,400	1,144	385	1,296	35	3,469	......	3,506	......	......	......	......	......	446	......	......	......	......	392	32,073
1886....	18,000	1,406	409	1,449	......	1,949	......	5,247	......	......	......	......	......	735	......	......	......	......	786	29,981
1887....	20,000	1,890	673	1,490	......	1,446	......	5,574	......	......	......	......	......	689	......	......	......	1,543	(b) 692	33,997
1888....	18,000	1,320	126	2,164	......	625	......	5,024	......	......	......	......	......	1,151	......	......	......	3,848	992	33,250
1889....	13,100	980	812	2,283	......	556	......	4,590	......	......	......	......	......	1,345	......	......	......	1,874	(c) 944	26,484
1890....	12,000	977	505	1,608	......	1,334	......	3,429	......	......	......	......	......	1,046	......	......	......	1,290	737	22,926
Total..	916,359	131,266	99,753	84,683	55,910	60,722	18,097	63,833	8,598	7,527	7,391	6,831	5,653	16,006	2,777	2,661	2,272	8,555	68,961	1,567,855

Production of quicksilver, in flasks, in California, from 1880 to 1890, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.(a)	Napa.(a)	Great Eastern.	Bradford. (b)	Various mines.	Total.
1880.												
January	1,539	203	142	760	1,000	550	......	205	39	......	232	4,670
February	1,809	96	310	965	535	565	......	375	110	......	130	4,895
March	2,155	443	239	1,286	730	565	......	251	210	......	98	5,977
April	1,667	165	103	611	645	574	......	161	96	......	239	4,261
May	1,938	226	356	1,130	560	572	......	315	164	......	90	5,351
June...........	1,985	269	127	819	550	585	......	420	142	......	386	5,283
July	1,688	250	135	933	......	540	......	455	118	......	70	4,189
August........	2,360	312	189	878	340	525	......	455	133	......	68	5,260
September.....	2,166	245	175	687	300	452	......	480	122	......	81	4,708
October........	1,858	216	166	865	1,100	557	......	358	57	......	98	5,275
November	2,238	539	96	1,209	500	467	......	591	42	......	66	5,748
December......	2,062	245	101	563	410	490	......	350	46	......	42	4,309
Total	23,465	3,209	2,139	10,706	6,670	6,442	......	4,416	1,279	......	1,600	59,926
1881.												
January	2,259	330	140	895	1,300	451	......	430	13	......	43	5,861
February	2,187	171	32	635	600	399	......	233	......	......	4	4,261
March	2,466	206	354	1,100	350	400	......	505	179	......	......	5,560
April	2,507	158	284	706	357	447	......	466	123	......	23	5,071
May	1,346	200	218	1,163	500	681	......	659	97	......	25	4,889
June...........	1,780	201	196	1,463	340	801	......	621	94	......	68	5,504
July	2,208	110	160	1,057	255	714	......	481	47	......	156	5,188
August........	2,260	209	190	1,139	300	585	......	490	57	......	120	5,350
September.....	2,090	212	187	1,076	201	457	......	592	113	......	37	4,965
October........	2,223	140	165	969	400	414	......	485	106	......	63	4,965
November	2,572	577	180	588	375	434	......	310	166	......	30	5,232
December......	2,162	261	88	361	250	458	......	280	70	......	15	3,945
Total	26,060	2,775	2,194	11,152	5,228	6,241	......	5,552	1,065	......	584	60,851
1882.												
January	1,632	179	178	623	50	395	......	430	144	......	33	3,664
February	1,924	121	145	460	210	348	......	440	98	......	21	3,767
March	2,078	160	70	359	200	505	......	459	91	......	24	3,946
April	2,110	127	174	319	229	486	......	525	57	......	......	4,027
May	2,446	269	211	354	13	521	......	737	55	......	5	4,611
June...........	2,318	121	131	522	30	456	......	485	76	......	28	4,167
July	2,522	169	195	579	......	410	......	380	111	......	15	4,381
August........	2,432	130	184	418	50	490	......	582	388	......	11	4,685
September.....	2,766	129	225	430	140	513	......	641	348	......	17	5,209
October........	2,844	266	251	370	60	516	......	580	229	......	13	5,129
November	2,619	156	96	280	81	200	......	718	306	......	55	4,511
December......	2,379	126	311	300	75	339	......	865	221	......	19	4,635
Total	28,070	1,953	2,171	5,014	1,138	5,179	......	6,842	2,124	......	241	52,732
1883.												
January	2,497	112	367	280	77	390	......	590	262	......	7	4,582
February	2,150	133	181	310	7	364	......	295	156	......	4	3,600
March	2,230	142	202	335	......	305	......	485	162	......	14	3,875
April	1,756	76	243	310	......	294	......	530	142	......	3	3,354
May	2,344	144	135	350	......	293	......	325	164	......	13	3,768
June	2,214	137	165	91	......	400	......	360	184	......	10	3,561
July	2,618	85	141	130	......	446	......	452	150	......	2	4,024
August	3,000	139	94	112	......	315	......	695	76	......	......	4,431
September.....	3,010	164	45	265	......	297	......	750	81	......	30	4,642
October........	2,672	272	109	206	......	215	......	521	134	......	......	4,129
November	2,212	115	78	160	......	208	......	613	102	......	......	3,488
December	2,297	87	134	63	......	342	......	274	56	......	18	3,271
Total	29,000	1,606	1,894	2,612	84	3,869	......	5,890	1,669	......	101	46,725
1884.												
January	1,440	103	127	263	......	373	329	135	28	......	7	2,805
February	1,458	59	104	....	......	241	276	174	9	......	......	2,321
March	1,606	36	123	68	......	223	249	152	2	......	......	2,459
April	1,785	75	50	76	......	232	422	69	......	......	......	2,709
May	1,672	125	53	200	......	169	245	6	......	......	......	2,470
June	1,859	44	118	....	200	258	215	......	......	......	......	2,694

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver, in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.(*a*)	Napa.(*a*)	Great Eastern.	Bradford.(*b*)	Various mines.	Total.
1884.												
July	1,543	29	71	52	200	258	374	101	......	......	......	2,628
August	1,804	63	47	20	306	334	228	110	......	......	......	2,912
September	1,448	67	52	35	58	354	136	169	58	......	......	2,377
October	1,625	115	68	25	160	328	153	90	104	......	......	2,668
November	1,900	157	32	53	150	230	132	240	91	......	......	2,985
December	1,860	152	36	98	105	292	172	130	40	......	......	2,885
Total	20,000	1,025	881	890	1,179	3,292	2,931	1,376	332	......	7	31,913
1885.												
January	1,700	190	40	24	......	172	189	131	37	......	......	2,483
February	1,506	70	24	85	35	245	96	180	75	......	......	2,316
March	1,500	80	......	83	......	314	88	145	33	......	19	2,262
April	2,003	80	......	69	......	340	142	145	37	......	......	2,816
May	2,000	75	......	194	......	269	62	190	......	......	3	2,793
June	1,750	62	50	91	......	330	112	250	63	......	5	2,713
July	1,750	75	43	209	......	321	45	191	50	......	10	2,694
August	2,104	80	49	150	......	324	118	175	......	......	47	3,047
September	1,986	95	57	85	......	347	201	180	......	......	77	2,978
October	1,598	85	42	123	......	236	52	185	65	......	82	2,468
November	1,576	122	43	61	......	292	54	190	43	......	87	2,468
December	1,977	130	37	122	......	279	150	235	43	......	62	3,035
Total	21,400	1,144	385	1,296	35	3,469	1,309	2,197	446	......	392	32,073
1886.												
January	1,431	70	42	100	......	339	162	147	73	......	34	2,398
February	1,100	175	24	108	......	274	132	192	53	......	45	2,103
March	1,522	20	21	91	......	226	209	218	43	......	75	2,425
April	1,256	90	36	172	......	115	328	172	62	......	62	2,293
May	1,600	101	18	36	......	99	228	128	76	......	95	2,381
June	1,806	110	19	113	......	126	276	123	71	......	78	2,722
July	1,572	95	24	98	......	138	345	138	64	......	127	2,601
August	1,240	105	35	119	......	156	313	74	76	......	84	2,202
September	1,210	179	30	100	......	107	303	82	64	......	33	2,108
October	1,280	106	50	150	......	171	392	124	65	......	52	2,390
November	1,900	180	76	191	......	109	477	209	55	......	35	3,232
December	2,083	175	34	171	......	89	313	162	83	......	66	3,126
Total	18,000	1,406	409	1,449	......	1,949	3,478	1,769	735	......	786	29,981
1887.												
January	1,904	162	76	185	......	56	450	181	51	......	12	3,077
February	1,700	149	43	40	......	86	240	150	......	......	......	2,408
March	1,584	110	48	95	......	105	125	275	74	......	140	2,456
April	1,671	157	29	105	......	90	200	212	91	......	31	2,586
May	2,040	126	27	50	......	152	100	215	80	......	40	2,830
June	1,700	127	93	170	......	126	200	220	82	......	104	2,822
July	1,567	175	57	125	......	194	200	205	56	201	40	2,820
August	1,517	160	61	90	......	108	200	275	72	220	78	2,881
September	1,535	297	42	120	......	123	400	160	26	195	25	2,923
October	1,405	171	64	140	......	132	300	304	66	228	49	2,859
November	1,225	113	71	214	......	127	165	247	82	295	74	2,613
December	2,152	148	62	156	......	147	300	250	9	232	34	3,485
Total	20,000	1,890	673	1,490	......	1,446	2,880	2,694	689	1,371	627	33,760
1888.												
January	2,650	118	......	292	......	61	246	235	84	179	84	3,949
February	1,730	82	......	156	......	64	105	223	79	243	51	2,733
March	1,400	90	......	150	......	43	95	288	108	270	37	2,481
April	1,579	110	......	138	......	96	143	324	153	292	28	2,862
May	1,610	125	......	155	......	69	226	820	80	357	95	3,037
June	1,500	120	......	189	......	26	94	845	110	454	118	2,956
July	1,100	120	......	167	......	34	50	248	94	463	83	2,359
August	1,109	110	......	215	......	29	......	347	93	527	117	2,547
September	1,178	60	......	195	......	42	......	370	58	357	88	2,348
October	1,269	185	36	180	......	47	......	440	88	294	96	2,635
November	1,400	90	30	176	......	28	......	475	82	220	103	2,604
December	1,475	110	60	151	......	87	......	450	122	102	92	2,739
Total	18,000	1,320	126	2,164	......	625	959	4,065	1,151	3,848	992	33,250

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver, in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.(*a*)	Napa.(*a*)	Great Eastern.	Bradford.(*b*)	Various mines.	Total.
1889.												
January	1,200	65	......	173	......	81	......	385	94	230	109	2,337
February	820	65	......	173	......	45	......	400	76	182	52	1,813
March	1,290	70	......	175	......	34	......	380	89	116	63	2,217
April	1,249	70	......	215	......	30	......	320	92	119	108	2,203
May	870	70	206	192	......	......	......	445	97	132	73	2,085
June	950	75	117	235	......	......	......	415	211	152	63	2,218
July	966	70	124	211	......	41	......	340	135	110	69	2,066
August	1,000	70	64	216	......	17	......	450	168	170	68	2,223
September	970	75	78	224	......	97	......	360	77	136	61	2,073
October	1,300	80	89	164	......	70	......	385	87	214	64	2,453
November	1,300	130	139	150	......	80	......	380	107	134	72	2,492
December	1,185	140	......	155	......	61	......	330	112	179	122	2,284
Total	13,100	980	812	2,283	......	556	......	4,590	1,345	1,874	924	26,464
1890.												
January	952	100	60	109	......	55	......	270	46	75	41	1,708
February	728	60	......	186	......	11	......	245	126	46	60	1,462
March	1,000	57	11	80	......	110	......	265	77	121	111	1,832
April	779	70	1	89	......	48	......	210	109	82	......	1,388
May	1,100	60	......	82	......	70	......	175	84	93	5	1,669
June	1,066	65	......	178	......	111	......	155	74	85	68	1,802
July	1,100	70	......	131	......	106	......	210	70	127	95	1,909
August	1,000	100	80	147	......	129	......	190	153	119	69	1,987
September	1,000	55	120	174	......	202	69	195	66	136	38	2,055
October	1,064	95	111	127	......	203	303	135	58	173	42	2,311
November	1,084	105	97	143	......	115	326	238	78	125	68	2,439
December	1,127	80	25	162	......	174	233	210	105	108	140	2,364
Total	12,000	977	505	1,608	......	1,334	931	2,498	1,046	1,290	737	22,926

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Prices.—The world's product of quicksilver was smaller than usual in 1889, and this, more than the local conditions in this country, made the price high in 1889 and higher in 1890 in London, where the rates are made practically for all markets. The product from Spain and Europe generally finds a market in London, and the first shipments from the mines all go there, except where orders from London specify the filling of contracts direct from the mines. The producers' stock accumulates in London. At the prices mentioned, this stock decreased from 47,000 flasks at the close of 1888 to 45,100 at the end of 1889, and this was further decreased in 1890. The following table continues the range in price for the period since quicksilver mining began in the United States:

Highest and lowest prices of quicksilver during the past forty-one years.

Years.	Price in San Francisco, per flask.		Price in London, per flask.	
	Highest.	Lowest.	Highest.	Lowest.
			£ s. d.	£ s. d.
1850	$114.75	$84.15	15 0 0	13 2 6
1851	76.50	57.35	13 15 0	12 5 0
1852	61.20	55.45	11 10 0	9 7 6
1853	55.45	55.45	8 15 0	8 2 6
1854	55.45	55.45	7 15 0	7 5 0
1855	55.45	51.65	6 17 6	6 10 0
1856	51.65	51.65	6 10 0	6 10 0
1857	53.55	45.90	6 10 0	6 10 0
1858	49.75	45.90	7 10 0	7 5 0
1859	76.50	49.75	7 5 0	7 0 0
1860	57.35	49.75	7 0 0	7 0 0
1861	49.72	34.45	7 0 0	7 0 0
1862	38.25	34.45	7 0 0	7 0 0
1863	45.90	38.25	7 0 0	7 0 0
1864	45.90	45.90	9 0 0	7 10 0
1865	45.90	45.90	8 0 0	7 17 6
1866	57.85	45.90	8 0 0	6 17 0
1867	45.90	45.90	7 0 0	6 16 0
1868	45.90	45.90	6 17 0	6 16 0
1869	45.90	45.90	6 17 0	6 16 0
1870	68.85	45.90	10 0 0	6 16 0
1871	68.85	57.35	12 0 0	9 0 0
1872	66.95	65.00	13 0 0	10 0 0
1873	91.80	68.85	20 0 0	12 10 0
1874	118.55	91.80	26 0 0	19 0 0
1875	118.55	49.75	24 0 0	9 17 6
1876	53.55	34.45	12 0 0	7 17 6
1877	44.00	30.60	9 10 0	7 2 6
1878	35.95	29.85	7 5 0	6 7 6
1879	34.45	25.25	8 15 0	5 17 6
1880	34.45	27.55	7 15 0	6 7 6
1881	31.75	27.90	7 0 0	6 2 6
1882	29.10	27.35	6 5 0	5 15 0
1883	28.50	26.00	5 17 6	5 5 0
1884	35.00	26.00	6 15 0	5 2 6
1885	33.00	28.50	6 15 0	5 10 0
1886	39.00	32.00	7 10 0	5 16 3
1887	50.00	36.50	11 5 0	6 7 6
1888	47.00	36.00	10 0 0	6 12 6
1889	50.00	40.00	9 15 0	7 10 0
1890	58.00	47.00	10 10 0	9 1 0
Extreme range in forty-one years.	118.55	25.25	26 0 0	5 2 6

The detailed prices for the year 1889 were as follows:

Prices per flask obtained in New York for California quicksilver in 1889.

Months.	Prices obtained in New York.		Netting in San Francisco freight and drayage $1.30.		Rothschild's quotation and equivalent for quicksilver laid down in New York, duty added.				Laid down in New York, duty added.		Outsiders' price.	
					English money.		U. S. Money.					
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
					£ s. d.	£ s. d.					£ s. d.	£ s. d.
Jan	$44.00	$43.00	$42.70	$41.70	9 10 0	9 10 0	$50.50	$50.50	$46.60	$43.55	8 15 0	8 3 6
Feb	43.25	40.00	41.95	38.70	8 10 0	7 10 0	45.25	40.00	43.40	39.30	8 3 0	7 7 6
Mar	40.50	39.00	39.20	37.70	7 15 0	7 10 0	41.25	40.00	41.40	39.30	7 15 6	7 7 6
April	42.00	40.00	40.70	38.70	8 0 0	7 12 6	42.60	40.60	42.60	40.60	8 0 0	7 12 6
May	45.25	42.75	43.95	41.45	8 10 0	8 5 0	45.25	44.00	44.85	41.85	8 6 6	7 17 0
June	48.00	48.00	46.70	46.70	9 10 0	8 15 0	50.50	46.60	47.70	43.55	8 19 0	8 3 6
July	49.00	46.00	47.70	44.70	9 15 0	9 10 0	51.75	50.50	50.20	46.60	9 8 6	8 15 0
Aug	49.00	48.00	47.70	46.70	9 15 0	9 15 0	51.75	51.75	49.95	48.90	9 7 6	9 3 6
Sept	49.50	48.50	48.20	47.20	9 15 0	9 15 0	51.75	51.75	49.15	48.75	9 4 6	9 3 0
Oct	49.00	48.50	47.70	47.20	9 5 0	9 5 0	49.30	49.30	49.30	47.30	9 5 0	8 17 6
Nov	50.00	49.00	48.70	47.70	9 15 0	9 10 0	51.75	50.50	50.90	49.95	9 11 0	9 7 6
Dec	50.00	48.50	48.70	47.20	9 15 0	9 15 0	51.75	51.75	50.85	49.30	9 9 0	9 5 0

Movement of quicksilver from San Francisco in detail, from 1883 to 1888.

To—	1883.	1884.	1885.	1886.	1887.	1888.
By sea:	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*
China	16,330	300	233	....	3,105	3,761
Japan	1,253	588	302	3	....	....
Mexico	10,764	5,404	5,884	5,530	6,397	4,766
South America	970	155	100	....	....	....
Australia	600	110	....	....	....	....
New Zealand	160	20	100	91	100	286
Central America	59	52	9	23	119	712
New York	3;100	8,350	9,055	600	8,370	2,320
Various	11	22	47	54	28	72
Total by sea	33,247	14,901	15,730	6,301	18,119	11,917
By rail:						
Central Pacific, Southern Pacific and Northern Pacific Railroads	4,620	(*a*) 7,000	(*a*) 10,000	10,000	4,000	7,833
Grand total	37,867	21,901	25,730	16,301	22,119	19,750

a Including about 3,500 flasks to Mexico by Southern Pacific Railroad.

Total exports and shipments of quicksilver in 1889 and 1890.

	1889.	1890.
BY SEA.	*Flasks.*	*Flasks.*
Mexico	4,593	2,795
Central America	47	102
Chile and South America	10	....
New Zealand	112	....
Australia	10	127
British Columbia	11	....
China	....	300
	4,783	3,324
Shipments to New York	430	320
Various	....	6
Total by sea	5,213	3,650
BY RAILROAD.		
From San José:		
New York	5,100	1,800
Philadelphia	....	300
Texas	200	....
Montana	1,995	2,115
Nevada	....	4,520
Utah	118	....
Colorado	....	30
Idaho	100	130
Arizona	90	10
Mexico	....	95
	7,603	9,000
From San Francisco:		
New York	1,500	....
Mexico	819	....
Montana, Idaho, and Utah	2,311	....
Arizona	110	....
Colorado	61	....
Various points	....	2,548
	4,801	2,548
From San Francisco, via Portland and Northern Pacific Railroad:		
Montana	350	....
Add for shipments to Montana, Idaho, and Arizona, not included in above	533	....
Total by rail	13,287	11,548
Total shipments	18,500	15,198

Quicksilver imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
June 30—	*Pounds.*		June 30—	*Pounds.*	
1867	....	$15,248	1880	116,700	$48,463
1868	152	68	1881	138,517	57,733
1869	....	11	1882	597,898	233,057
1870	239,223	107,646	1883	1,552,738	593,307
1871	304,965	137,332	1884	136,615	44,035
1872	370,353	189,943	1885	257,659	90,416
1873	99,898	74,146	December 31—		
1874	51,202	52,093	1886	629,888	249,411
1875	6,870	20,957	1887	419,934	171,431
1876	78,902	50,164	1888	132,850	56,997
1877	38,250	19,558	1889	341,514	162,064
1878	294,207	135,178	1890	802,871	445,807
1879	519,125	217,770			

Imports of quicksilver vermilion from 1867 to 1890.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
June 30—	*Pounds.*		June 30—	*Pounds.*	
1867	....	$123,506	1880	11,952	$5,997
1868	....	90,648	1881	14,243	7,391
1869	247,382	145,665	1882	12,496	6,214
1870	104,523	57,262	1883	19,549	8,795
1871	79,195	43,935	1884	....	10,472
1872	120,067	49,237	1885	....	8,244
1873	87,008	65,796	December 31—		
1874	42,324	39,443	1886	....	11,016
1875	9,460	10,831	1887	....	16,542
1876	18,981	17,679	1888	....	9,342
1877	23,315	14,660	1889	....	3,263
1878	9,843	5,772	1890	....	6,916
1879	11,382	6,105			

Mercurial preparations imported and entered for consumption in the United States, 1867 to 1883, inclusive. (a)

Fiscal years ending June 30—	Blue-mass.		Calomel.		Mercurial preparations not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	....	....	....	$4,242	....	$4,242
1868	....	....	....	4,440	....	4,440
1869	....	....	....	4,516	....	4,516
1870	....	....	....	6,306	....	6,306
1871	....	....	....	3,147	....	3,147
1872	1,009	$667	8,241	6,590	$629	7,886
1873	919	660	5,520	5,240	699	6,599
1874	259	192	6,138	6,676	4,334	11,202
1875	125	109	2,424	2,817	52	2,978
1876	489	365	5,433	5,820	92	6,277
1877	455	327	4,649	4,305	90	4,722
1878	397	252	4,188	3,576	363	4,191
1879	485	266	5,875	4,635	6,453	11,354
1880	533	262	4,780	3,230	30	3,622
1881	395	236	8,177	5,640	116	5,992
1882	207	124	5,215	3,411	58	3,593
1883	188	79	8,732	5,503	190	5,772

a Not specified since 1883.

World's annual production.—The following table, by Mr. Randol, shows the product in various countries for the past ten years, and its relation to the consumption and the stock:

The world's production of quicksilver for ten years.

[Flasks of 34.5 kilograms, or 76.5 pounds avoirdupois.]

Years.	California.	Spain.		Austria-Hungary.		Italy. (c)	Russia.	Estimated consumption.	Estimated stock in London, England.	Total supply.
		Almaden.	Various. (a)	Idria.	Various. (b)					
1880.....	59,926	45,322	(d)	12,356	712	4,220	....	95,600	68,500	122,536
1881.....	60,851	44,989	(d)	11,333	720	4,785	....	106,300	84,899	122,678
1882.....	52,732	46,716	2,795	11,663	588	4,900	....	116,200	88,000	119,394
1883.....	46,725	49,177	2,165	13,152	709	6,930	....	124,800	82,014	118,858
1884.....	31,913	48,098	2,219	13,967	733	8,500	....	111,300	76,105	105,430
1885.....	32,073	45,813	2,046	13,503	773	7,540	....	108,300	69,467	101,748
1886.....	29,981	51,199	2,277	14,496	1,400	8,235	....	123,050	54,000	107,588
1887.....	33,760	53,276	2,894	14,676	1,030	9,220	1,855	131,700	39,000	116,711
1888.....	33,250	51,872	1,877	14,962	1,018	10,200	4,777	109,900	47,000	117,956
1889.....	26,464	49,477	(d)	15,295	(e) 1,125	11,174	10,307	115,740	45,100	113,842
Total.	407,675	485,939	16,273	135,403	8,808	(c) 75,704	16,939	1,142,890	....	1,146,741

a Comprises mines in the provinces of Oviedo, Granada, and Cuidad Real.

b Comprises mines in Carniola and in Hungary.

c Figures taken from monograph on the quicksilver mines of Monte Amiata, by P. De Ferrari, M. E., 1889.

d Quantities unknown.

e Comprises mines in Carniola only, the production of Hungary not being known.

CENSUS STATISTICS.

The following data have been condensed from the very careful results of the census as taken by the expert special agent, Mr. Randol, in charge of that branch:

Location and number of all the quicksilver establishments—by States and counties.

States.	Counties.	Productive.		Nonproductive.	
		Mines.	Furnaces.	Mines.	Furnaces.
California.........	Lake..........................	3	12	....	....
	Merced........................	1	(a)	....	....
	Napa..........................	4	12	....	....
	San Benito....................	1	3	....	....
	Santa Clara...................	1	7	1	4
	Sonoma........................	1	2	....	....
	Siskiyou......................	....	....	1	(a)
	Trinity.......................	....	....	1	....
Oregon...........	Douglas.......................	....	....	3	3
	Total.....................	11	36	6	7

a One retort.

The productive mines and active furnaces employed 937 operatives, of whom 416 were engaged on surface work and 521 were employed underground. The other mines and furnaces employed 24 men, making a total of 961 employés, as shown in the following table:

Number of employés.

Employés.	Productive mines and furnaces.	Nonproductive mines and furnaces.	Total.
Men	932	24	956
Women	1	....	1
Boys	4	....	4
Total	937	24	961
Total on surface	416	18	434
Total underground	521	6	527
Total	937	24	961

Production statistics.—Of 95,714 tons (2,000 pounds each) of cinnabar ore mined, 92,964 tons were roasted, producing 26,484 flasks of quicksilver, each containing a standard quantity of 76½ pounds advoirdupois. Of the eleven establishments working ore, one reported only 200 tons produced and worked in retorts, with an average yield of 2.295 per cent, the highest percentage returned. The lowest average yield was 0.286 per cent, and the average percentage yield in quicksilver for all the ore roasted was 1.088. The largest quantities of ore produced and roasted were respectively 28,007 and 28,887 tons, and the quantity of quicksilver produced at the several works ranged from 120 up to 13,100 flasks. The following table exhibits the quantity of ore produced and roasted in California in 1889, the number of flasks of quicksilver produced, and the prcentage of yield:

Yield of quicksilver from California ores roasted in 1889.

Number of establishments.	Ore produced.	Ore roasted.	Quicksilver produced.	Yield.
	Short tons.	*Short tons.*	*Flasks.*	*Per cent.*
1	7,168	7,168	1,874	1.000
1	9,880	9,880	2,283	0.884
1	7,440	7,440	556	0.286
1	200	200	120	2.295
1	4,742	3,992	812	0.778
1	23,500	23,500	4,590	0.746
1	3,400	3,400	804	0.905
1	3,377	3,377	980	1.110
1	28,007	28,887	13,100	1.734
1	7,000	5,120	1,345	1.000
1	1,000	....	....	....
11	95,714	92,964	(*a*) 26,464	1.088

a One mine in Oregon produced 20 flasks, the total product in that State. They are not included, being less than $1,000 in value.

Expenditures.—The following table shows the value of supplies of all kinds consumed during the year 1889; "the aggregate of all wages paid;" total of all other expenditures for mines and works, including rent, taxes, etc.; number of flasks of quicksilver produced, and average cost per flask:

Expenditures in the production of quicksilver in California in 1889.

Number of establishments.	Value of all supplies.	Aggregate of all wages..	Total of all other expenditures.	Number of flasks quicksilver produced.	Average cost per flask.
1	$53,567	$104,608	$760	4,590	$34.63
1	5,975	8,060	....	....	(*b*)
1	(*a*) 4,000	20,936	750	804	31.95
1	4,000	12,591	1,000	812	21.66
1	9,564	43,241	1,042	1,874	28.73
1	21,973	47,208	2,507	2,283	31.40
1	9,034	25,352	2,167	556	65.74
1	1,500	2,250	....	120	31.25
1	3,114	27,546	79	980	31.37
1	86,428	304,341	26,826	13,100	31.88
1	20,467	30,156	359	1,345	37.90
11	219,622	626,289	85,490	26,464	32.71

a Estimated; correct amount unobtainable.

b Ore mined, but not roasted, and therefore omitted in average cost per flask.

From the above table it will be seen that at eleven active establishments there were expended $219,622 for supplies, $626,289 for wages, and $35,490 for other expenses, embracing taxes, rent, interest, etc., making a total of $881,401, showing that 71 per cent was paid for wages, 25 per cent for supplies, and 4 per cent for all other expenses. Of the amount paid for wages the office force absorbed $34,966, and there were paid to foremen, mechanics, miners, furnace hands, and laborers $591,323.

Prices.—The cost per flask of quicksilver produced ranged from $65.74 to $21.66, the average cost for all being $32.71.

For the year the highest price was $50 and the lowest $40, giving an average of $45, which for the year's production, 26,484 flasks, would make a total valuation of $1,191,780. The difference between the cost, $881,401, and value, $1,191,780, is $310,379, which may be regarded as the profit on the year's work, based on the returns collected. The difference between average cost and average sale price was $11.69 per flask. The one establishment producing quicksilver at a cost of $65.74 per flask, of course, met with a serious loss on its output.

Wages.—The wages in the table appended show considerable variations, depending largely upon the locality of the work, its importance, and the degree of skill required for its performance. On work at surface, foremen were reported to earn daily wages ranging from $10.33 to $2.66; mechanics, $3.60 to $2.05; laborers, $2 to $1.18, the last-named rate being for Chinamen. Boys under 16 years of age, of whom only four were employed, none underground, earned $1 and 75 cents.

The following table gives the number and classification of employés on surface (excepting the office force), daily wages, and number of days' work for the year:

Wages of employés above ground in quicksilver mining.

Number of establishments.	Foremen.			Mechanics.			Number of establishments.	Laborers.			Boys under 16.		
	Average number employed daily.	Average wages per day.	Average number of days' work for year.	Average number employed daily.	Average wages per day.	Average number of days' work for year.		Average number employed daily.	Average wages per day.	Average number of days' work for year.	Average number employed daily.	Average wages per day.	Average number of days' work for year.
1	1	$2.90	365	(*a*) 5	$2.80	301	1	(*e*) 11	$1.38	300	......	......	......
1	2	10.33	360	5	2.50	360	1	15	1.75	360	......	......	......
1	1	2.81	157	2½	3.20	90	1	6	2.00	300	......	......	......
1	......	......	......	1	3.60	300	1	17	1.73	265	......	......	......
1	4	2.86	349	(*b*) 42½	2.38	306	1	(*f*) 87	1.18	284	......	......	......
1	1	2.75	340	5	3.00	340	1	(*g*) 98	1.94	281	3	$0.75	187
1	......	......	......	2	2.05	320	1	38	2.00	340	1	1.00	310
1	2	2.66	365	......	......	......	1	(*f*) 12	1.30	300	......	......	......
							1	(*f*) 2	1.37	308	......	......	......
8	11	(*c*) 10.33 (*d*) 2.66	(*c*) 365 (*d*) 157	63	(*c*) 3.60 (*d*) 2.05	(*c*) 360 (*d*) 90	9	286	(*c*) 2.00 (*d*) 1.18	(*c*) 360 (*d*) 265	4	(*c*) 1.00 (*d*) 0.75	(*c*) 310 (*d*) 187

a Mechanics comprises engineers, $2.90; blacksmiths, $2.90; and furnace men, $2.65 per day.

b Mechanics comprise carpenters, $3; masons, $5; blacksmiths, $2.10; helpers, $1.03; engine-drivers $2.39; machinists and helpers, $3.67, as their average earnings per day.

c Highest wages.

d Lowest wages.

e Laborers embrace men sorting ore, $1.25; teamsters, $1.65 per day.

f Chinese.

g Laborers comprise furnace hands earning $2 to $2.25 per day; ordinary laborers, earning $2 per day; and ore cleaners, earning $1.75 per day.

One establishment reported 42 men employed on surface and underground work without classification or number of days employed, miners at $2.10 and laborers at $1.75 per day. Another establishment reported 11 white men on surface without classification, at $2.80 per day for 352 days. These establishments were not included in the tables.

The following tables exhibit the number and classification of workers underground, their daily wages, and the number of days' work for the year. For foremen at underground work the average wages ranged from $4.68 to $2.75 daily. Miners earned an average of $2.67 to $1.22, the lowest rate being for Chinamen, of whom a few were employed at small establishments.

Wages of foremen and miners underground.

Number of establishments.	FOREMEN.			MINERS.			LABORERS.		
	Average number employed daily.	Average wages per day.	Average number of days' work for year.	Average number employed daily.	Average wages per day.	Average number of days' work for year.	Average number employed daily.	Average wages per day.	Average number of days' work for year.
1	1	$2.90	340	(a)6	$2.40	300	(f)24	$1.90	290
1	1	4.00	360	20	2.67	360	5	2.17	360
1	....	....	....	22	2.45	263	1	2.00	300
1	1	2.75	110	b5	1.22	40	19	2.09	267
1	2	4.68	306	(c)233	2.66	279	(f)25	1.50	340
1	3	3.06	340	(b)80	1.25	340	3	1.65	315
1	1	4.50	316	6	2.05	284	4	1.35	336
1	....	....	....	6	1.50	336	....	....	....
8	9	(d)4.68 (e)2.75	(d)360 (e)110	378	(d)2.67 (e)1.22	(d)360 (e)40	81	(d)2.17 (e)1.35	(d)360 (e)267

a Miners embrace timbermen and machine drill men.

b Chinese.

c Miners comprise tributers, $2.41; drillers per foot on contract, $2.33; drifting on contract, $2.80; timbermen, $3; blasters, $2.75 per day.

d Highest.

e Lowest.

f Laborers embrace helpers and hand drillers at $1.90 per day.

The following table gives the number of office force, total pay of same, total wages of all other employés, and the aggregate wages paid to all employés:

Total wages.

Number of establishments.	Number employed.	Total pay.	All other wages.	Total wages.
1	....	....	$25,352	$25,352
1	....	....	2,250	2,250
1	....	....	20,936	20,936
1	1	$800	29,356	30,156
1	3	2,520	(b)40,721	43,241
1	2	3,900	23,646	27,546
1	2	3,366	43,842	47,208
1	7	17,560	(c)286,781	304,341
1	(a)3	5,200	99,408	104,608
1	1	1,200	(d)11,391	12,591
1	1	420	7,640	8,060
11	20	34,966	591,323	626,289

a Only one woman employed in all the establishments.

b $300 paid to contractors included.

c $10,606 paid to contractors included.

d $375 paid to contractors included.

During the census decade, 1880–1889, there were no strikes or labor troubles of any kind in any of the mines and works.

POWER.—The active establishments employed 62 steam motors, with a capacity of 2,190 horse power, 54 boilers of 2,438 horse power, one electric dynamo and motor of 4 horse-power, and one water wheel of 3 horse power—a total of 2,197 horse power in motors. Two hundred and forty-seven animals were also reported as employed, but it is probable a greater number were in use. The details for the respective establishments are shown in the following table:

Power used in quicksilver mining and reduction.

Number of establishments.	Steam motors.		Boilers.		Other motors.		Number of animals.
	Number.	Horse power.	Number.	Horse power.	Number.	Horse power.	
1	2	50	2	80	....	....	4
1	5	230	5	140	....	....	4
1	3	90	2	125	....	....	4
1	2	150	5	155	....	....	12
1	2	50	4	100	....	....	12
1	7	185	5	400	....	....	15
1	29	1,000	23	1,088	2	(a) 7	114
1	5	170	8	200	....	....	52
1	7	265	5	200	....	....	20
1	....	....	....	....	....	....	10
10	62	2,190	54	2,438	2	7	247

a One water wheel of 3 horse power, and one dynamo and motor of 4 horse power.

The following statement gives an estimated valuation of the active mines and works as nearly as the same could be ascertained:

Value of quicksilver establishments.

Number of establishments.	Mines and real estate.	Furnaces, houses, and other surface improvements.	Machinery, supplies, tools, and live stock.	Quicksilver unsold.	Bills and accounts receivable.	Other assets.	Estimated total capital.
1	$276,530	$50,000	$58,850	$96,660	....	$108,518	$590,553
1	30,000	13,300	2,000	4,700	....	....	50,000
1	65,000	25,000	10,000	6,460	....	2,000	108,460
1	6,940	14,000	3,300	95	....	....	24,535
1	20,000	5,000	5,000	2,500	....	....	82,500
1	100,000	25,000	30,000	....	....	....	155,000
1	12,000	5,000	10,000	....	....	....	27,000
1	20,000	10,000	5,000	859	$9,664	4,943	50,466
1	50,000	25,000	10,000	2,900	25,000	10,000	122,900
1	25,000	15,000	10,000	9,900	....	....	59,900
(a) 6	75,000	35,000	2,000	....	....	....	112,000
16	680,470	222,300	146,150	124,074	34,664	125,456	1,333,114

a Nonproductive.

Some mine owners placed a higher valuation on their mines and improvements than is given in the foregoing statement; but it is preferred to take what may be considered a conservative opinion of the values as of December 31, 1889. Undoubtedly the original investments in the properties were many times the amounts of present estimates, but it must be remembered that mines are generally decreased in value by the extraction of ore for a long period of continuous work, which has been the case with the quicksilver establishments of the United States.

Exports of domestic quicksilver from the United States for the ten years ended December 31, 1889.

[Compiled from the returns sent in by the various collectors of customs.]

Ports.	1880.		1881.		1882.		1883.	
	Flasks.	Dollars.	Flasks.	Dollars.	Flasks.	Dollars.	Flasks.	Dollars.
Ports from which exported:								
San Francisco	34,359	1,028,826	33,935	985,927	33,728	983,977	29,928	804,077
New York	2,221	76,244	1,166	39,161	143	4,344	137	4,037
Philadelphia	630	14,882	......	......	......	......	......	......
Boston	......	......	6	211	4	133	7	239
New Orleans	......	......	......	......	......	......	......	......
Total	37,210	1,119,952	35,107	1,025,299	33,875	988,454	30,072	808,353
Exported to—								
Hongkong	19,610	577,019	17,031	493,171	18,965	560,353	16,356	438,689
Central American States	41	1,095	38	1,086	75	2,151	150	4,263
Chile	754	24,842	123	3,700	1,400	42,000	1,150	31,250
China	50	1,475	......	......	......	......	......	......
Germany	......	......	......	......	......	......	......	......
England	1,753	59,882	......	......	......	......	......	......
British Columbia	7	211	5	141	16	472	4	110
British possessions in Australasia	1,535	47,874	1,330	37,249	1,831	52,997	786	20,766
Japan	105	3,050	314	9,213	621	17,601	1,297	32,151
Mexico	12,418	376,007	15,256	450,448	10,128	288,441	10,157	276,332
Peru	440	13,540	700	20,161	665	19,285	100	2,695
Cuba	356	10,270	......	......	1	33	......	......
United States of Colombia	115	3,673	208	6,487	45	1,280	11	326
Venezuela	13	497	90	3,225	98	2,941	36	1,028
Dutch Guiana	1	26	12	418	4	133	5	175
Nova Scotia, New Brunswick, and Prince Edward Island	......	......	......	......	......	......	2	64
West Indies	......	......	......	......	18	552	18	504
All other ports	17	491	......	......	8	215	......	......
Total	37,210	1,119,952	35,107	1,025,299	33,875	988,454	30,072	808,353

Exports of domestic quicksilver from the United States, etc.—Continued.

Ports.	1884.		1885.		1886.		1887.	
	Flasks.	Dollars.	Flasks.	Dollars.	Flasks.	Dollars.	Flasks.	Dollars.
Ports from which exported:								
San Francisco	7,037	189,420	6,547	200,739	5,845	196,384	10,401	396,316
New York	332	10,233	242	8,578	240	8,340	984	44,448
Philadelphia								
Boston			8	291	6	232	9	348
New Orleans	1	32	5	150				
Total	7,370	199,685	6,802	209,758	6,091	204,956	11,394	441,112
Exported to—								
Hongkong	220	6,750	233	8,990			3,323	141,237
Central American States	285	8,390	238	8,341	164	5,805	177	6,466
Chile			104	3,042				
China								
Germany								
England							800	36,200
British Columbia	15	406	40	1,088	59	1,902	81	1,104
British possessions in Australasia	130	3,768	75	2,257	90	3,295	100	3,965
Japan	669	16,032	300	9,100	3	108		
Mexico	5,830	157,758	5,777	175,828	5,678	190,461	6,920	250,514
Peru	50	1,550						
Cuba	11	351			5	180		
United States of Colombia	80	2,376	14	498	22	873	32	1,196
Venezuela	36	1,057			60	1,946		
Dutch Guiana			5	176	2	77	3	129
Nova Scotia, New Brunswick, and Prince Edward Island			2	76	6	232	7	261
West Indies	18	529			1	44		
All other ports	26	718	14	362	1	33	1	40
Total	7,370	199,685	6,802	209,758	6,091	204,956	11,394	441,112

Ports.	1888.		1889.		Total.	
	Flasks.	Dollars.	Flasks.	Dollars.	Flasks.	Dollars.
Ports from which exported:						
San Francisco	10,145	381,707	5,049	210,745	176,974	5,378,118
New York	539	24,692	62	2,972	6,066	223,049
Philadelphia					630	14,882
Boston					40	1,454
New Orleans					6	182
Total	10,684	406,399	5,111	213,717	183,716	5,617,685
Exported to—						
Hongkong	3,713	144,899			79,451	2,371,108
Central American States	1,333	52,586	93	4,111	2,594	94,294
Chile			12	475	3,543	105,309
China	37	1,386			87	2,861
Germany						
England					2,553	96,082
British Columbia	16	548	12	424	205	6,406
British possessions in Australasia	322	12,979	133	5,488	6,332	190,638
Japan	35	1,450			3,344	88,705
Mexico	5,172	190,013	4,841	202,228	82,172	2,558,030
Peru					1,955	57,231
Cuba	2	127	2	122	377	11,083
United States of Colombia	48	2,096	6	313	581	19,118
Venezuela					333	10,694
Dutch Guiana	5	265			37	1,399
Nova Scotia, New Brunswick, and Prince Edward Island			6	272	23	905
West Indies					55	1,629
All other ports	1	50	6	284	74	2,193
Total	10,684	406,399	5,111	213,717	183,716	5,617,685

The final census volume on mining contains also an exhaustive treatise of very great value on the mining plant, etc., of New Almaden, which should be read entire, and will not bear further condensation.

ALUMINUM.

By R. L. Packard.

The production of aluminum still remains small when compared with that of other metals used in the arts. The newspaper prophecies of the advent of the "age of aluminum," which were frequent a few years ago, are still unfulfilled, and the tone of the technical and trade journals is changing from that of expectancy to one of criticism. Enough has now been published of the methods of production of the metal and of its availability for different purposes to afford a basis for an estimate of its value and to place it upon a different footing from that which it occupied when its properties were less well known. The newspapers proper still occasionally herald a new process for extracting aluminum which is to be cheaper than its predecessors, but that part of the public which is interested in such matters is no longer eager to listen to statements of this character. Nevertheless, there is a real and very considerable advance in the production of this metal, both in Europe and the United States, and from a technological point of view it is a thing of great interest to witness the development of a laboratory experiment into an established commercial process, by which a metal formerly practically unknown has been introduced into the markets of the world, and this development has taken place in the case of aluminum within the last thirty years. It has been estimated that the total amount of the metal produced during this period (up to the close of 1889) was only about 116 tons, but the indications in 1889 were that this quantity would soon be exceeded by the annual production.

It is very likely that such is already the case, although figures are not at hand to show whether the prediction is actually verified or not, but the aluminum industry has received a new impetus in Europe within a short time and the American production has also been very largely increased. The total output of metallic aluminum in the United States in 1890 was 47,881 pounds, against 19,200 pounds in 1889. If to this is added the aluminum contained in alloys produced here in 1890, which was in round numbers 13,400 pounds, the total is 61,281 pounds of aluminum extracted in this country during the year.

From its first appearance aluminum has been used principally for articles which it is desired should be light and strong, such as parts of mathematical, astronomical, optical, and surveying instruments, light weights, fittings of various kinds, dental plates, surgical apparatus, and the like. The limited production of the metal and its high cost up to a very recent date precluded its use in any large way. Its cost is now (1890) reduced to below $2 a pound. The scope of its employment for articles of manufacture is still limited, as above indicated, while its production for such employment is very largely increased, and although the field of its possible uses is as wide as the imagination of newspaper writers can make it, these uses are as yet only unrealized suggestions. Its use in metallurgy, which is extending, is another matter. Instrument-makers now use aluminum more than formerly, especially where great rigidity is not required.

An illustration of this statement is afforded by a note read by Prof. William P. Blake before the American Institute of Mining Engineers in 1890. He described a double reflecting and repeating circle invented by Capt. Charles H. Townshend, of New Haven, Connecticut, and exhibited one of the instruments made by Messrs. Stackpole & Brothers, of New York. The circle, which was 9 inches in diameter, was cast in one piece. The aluminum was furnished by the Pittsburg Reduction Company. The instrument is intended to be used in a boat and is to be held in one hand like a sextant. Lightness, therefore, is of great importance. The instrument, exclusive of the eyepieces and handle, weighed only 1 pound. An inspection showed that in this case the metal worked well under the file, in the lathe, and under the graduating tool. The castings were homogeneous, free from blowholes, and dressed up clean and sharp. Messrs. Keuffel & Esser, of New York, have made sextants of aluminum which have proved satisfactory as far as the limited experience in their use has gone. The same manufacturers are also making a mining transit of aluminum, although some portions of the instrument are made of a harder and heavier metal. The great advantage of lightness in such instruments will be appreciated by these who have had to carry instruments of the usual construction through the devious passages of mines and up the side of high mountains, where every ounce of weight is a grievous burden. Moreover, since aluminum resists corrosion to a remarkable degree, instruments made of it are not liable to tarnish and do not require lacquer as brass instruments do, and their unprotected surfaces keep clean and bright where brass and ordinary bronze will become green and dirty.

Some instrument-makers are yet cautious in the use of unalloyed aluminum, preferring to employ it only in those parts of apparatus where lightness is important while great rigidity and hardness are not required, and which have careful handling. To increase the rigidity and hardness of the metal without materially increasing its weight, it has been proposed to alloy it with small quantities of other metals. For this purpose an alloy of aluminum, and silver, suggested by Tissier, has been made by Mr. Hunt, having the composition of 95 per cent aluminum and 5 per cent silver. This alloy is much harder and more rigid than aluminum, and works quite as well or better under tools. Its specific gravity is 3.2, so that it is a little heavier than aluminum (2.6). It is whiter than the pure metal, withstands corrosion nearly as well, takes a good polish, and is better for graduation. In France, aluminum has also been alloyed with tin (nearly 10 per cent) for the same purpose. The specific gravity of this alloy is said to be 2.85, it is not easily corroded, can be worked more satisfactorily than aluminum, and has the great advantage of being as easily soldered as bronze. Aluminum wire has been substituted for lead as calking for steam pipes, on account of its resistance to the action of steam. It is made into steamers for evaporating fruit juices, to avoid the action of the fruit acids on galvanized and tinned ware. Trolley wheels on electric cars have been advantageously made of it, and new uses of this general character are frequently mentioned. This confirms the statement made at the outset that the scope of the employment of aluminum for articles of manufacture is yet limited to such as must be light and resist corrosion well. It has not yet (1890) begun to displace other metals to any noticeable extent in a large way.

Aluminum is used metallurgically in the manufacture of iron and steel, to which it is added before pouring, sometimes in the form of the alloy ferro aluminum and sometimes as metallic aluminum. A recent discussion of this subject will be noticed farther on. It is also used in this country in making alloys, especially aluminum bronze. No data are at hand to indicate what proportion of the total production is used in the arts to be drawn, rolled, cast, etc., into articles of manufacture, and what is used matallurgically and in the manufacture of alloys.

The following table showing the comparative physical properties of aluminum, iron, and copper is inserted here for convenience of reference. It must, however, be remembered that figures representing the tensile strength of aluminum given by different authorities are apt to disagree because the specimens which afforded the figures in the different cases did not have the same composition. The table is taken from an address delivered before the London Society of Chemical Industry by J. H. J. Dagger, F. I. C., F. C. S.:

Comparison of aluminum with iron and copper.

——	Aluminum.		Iron.		Steel.	Copper.	
	Cast.	Rolled.	Cast.	Wrought.		Cast.	Rolled.
Color	Bluish white.		White.	Gray.	——	——	——
Density	2.5	2.7	7.5	7.1-7.8	7.7-7.2	8.96	
Weight per cubic foot in pounds.	162		450	485	490	555	
Melting point	1,300° F.	....	2,780° F.	above 4,000° F.	4,000° F.	1,990° F.	
Tensile strength in pounds per square inch.	20,000 to 25,000.	30-35,000	15,680 lb. (7 tons)	45-60,000 (19-27 tons)	60-90,000 (40-45 tons)	20,000 (does not cast as well as Al.)	30-40,000 lb.
Elongation per cent	14	3.0	....	7-22	5-15	....	20-40
Specific heat(*a*)	0.218	....	.1138	....	....	.0952	....
Electrical conductivity.	34.0	....	16		....	99	
Thermal conductivity.(*b*)	33.7	....	11.9		....	75	

a Higher than any metal except lithium and glucinium.

b Ag. = 100.

As mechanical difficulties are found in working aluminum, the following directions from an authentic source are given for the benefit of those who have occasion to work the metal. They are from a paper read at the Washington meeting of the American Institute of Mining Engineers, February, 1890, by Messrs. Alfred E. Hunt, John W. Langley, and Chas. M. Hall:

"*Annealing.*—A very low and even temperature should be maintained in the muffle. Aluminum melts at about 1,300 degrees Fahrenheit—a very dark red. The inexperienced, therefore, can not judge the proper annealing temperature by the eye alone without danger of fusing the metal. When the metal has been heated enough to char the end of a pine stick, thus leaving a black mark in the wake of the stick as it is drawn across the metal, it is sufficiently annealed. The metal should then be withdrawn from the furnace and allowed to cool slowly in the air. For some work, such as stamping and drawing, it is sometimes better not to heat the metal so hot as to leave a dead black mark with the stick, but just enough to show a dark brown mark instead. Very thin sheets or wire can be annealed sufficiently for some purposes in boiling water.

"*Dipping and picking.*—Remove the dirt and grease from the plates by dipping in benzine. To whiten the metal, leaving on the surface a beautiful white mat, the sheet should be first dipped in a strong solution of caustic potash. This solution should then be dipped in a mixture of concentrated acids, two parts nitric acid to one of sulphuric acid; then in a solution of undiluted nitric acid; then in a mixture of vinegar and water, equal parts; then washed thoroughly in water and dried as usual in hot sawdust.

"*To polish.*—Use a fine polishing composition, or rouge, or tripoli, and a sheepskin or chamois skin buff, although it is often polished with an ordinary rag buff. For fine work, to polish aluminum, use a mixture of equal parts, by weight, of olive oil and rum, made into an emulsion by being well shaken together in a bottle. The polishing stone is dipped in this liquid, and the metal is polished without using, however, too much pressure. Aluminum may be easily ground by using olive oil and pumice. The surface of aluminum, treated with varnish of four parts oil of turpentine to one of stearic acid, or with a mixture of olive oil and rum shaken into an emulsion, allows an engraving tool to work on aluminum as on pure copper.

"*For burnishing.*—Use a bloodstone or steel burnisher. For hand burnishing use either kerosene oil or a solution composed of 2 tablespoonsful of ground borax dissolved in about a quart of hot water with a few drops of ammonia added.

"*For lathe work.*—The burnisher should wear upon the fingers of his left hand a piece of Canton flannel, keeping it soaked with kerosene, and bringing it in contact with the metal, supplying a constant lubricant. Very fine effects can be produced by first burnishing or polishing the metal and then stamping it in polished dies, showing unpolished figures in relief.

"*Scratch brushing.*—Polish or burnish the surface and then use a fine steel scratch brush. A very fine finish is attained by rubbing with ground pumice stone and water. In spinning aluminum, plenty of oil should be used to prevent the clogging of the tool and to make it cut smooth in the turning and to assist in the spinning.

"*To solder aluminum.*—Soldering the metal in large surfaces has not been successfully accomplished up to the present. Small surfaces of the metal can be readily soldered by the use of pure zinc and Venetian turpentine. Place the solder upon the metal with Venetian turpentine and heat gently with a blowpipe until the solder is melted. It will then be found to have fixed itself firmly to the aluminum. The trouble with this, as with other solders, is that it will not flow on the metal. Therefore large surfaces are not easily soldered. In cold-rolling aluminum, upon a roll designed for cold-rolling hard crucible steel, it has been found possible to reduce aluminum through the same sections as hard steel; the aluminum required, on the average, five annealings, where the steel required three to satisfactorily withstand the same work.

"*Sand castings.*—Use open but very fine sand and bake the mold. Large feeding gates should be provided and the mold should be well vented. Pour the metal quickly at a temperature but little above the melting point. Use plumbago crucibles."

The following translation from a German technical paper, the "Neueste Erfindungen und Erfahrungen," has appeared in the papers here. It is reproduced on account of its possible practical value:

"Sheet aluminum may readily be soldered if previously given a light plating with copper. If aluminum so prepared is suddenly heated, there is considerable stripping of the copper, rendering the joint unreliable. Nevertheless, in many cases, the process is very satisfactory, and particularly so when the copper-plated edges are allowed to lap over each other.

"Aluminum bronze containing as much as 5 per cent. of aluminum may be readily soft soldered with ordinary tin solder. Increasing percentages of aluminum render the soldering more and more difficult, until with 10 per cent. of aluminum it becomes impossible. The method above referred to, of slightly plating with copper, will be found a help in such cases. When no tank is convenient for dipping the edges into the plating solution, very fair results may be obtained by using a number of pieces of blotting paper well soaked with solution of cupric sulphate. The paper is placed in contact with the article to be plated and with a piece of copper. The battery is then attached by wires with the positive pole to the copper and the negative pole to the casting or other object to be plated. A very short time is sufficient to give a plating heavy enough for soldering purposes. If for any reason a battery is not attainable for plating, the bronze may be prepared with a mixture of resin, tallow, neutral chloride of zinc, and corrosive sublimate.

"Hard soldering offers no difficulties. A good solder for this purpose is made by smelting together 52 parts copper, 46 parts zinc, and 2 parts tin. Borax is used as the flux, and the process is the usual one. Tests of joints made with this solder were made at Neuhausen, and showed that aluminum bronze plates butted together gave a resistance to pulling strain of 26 to 28 kilograms per square millimeter; lapped joints (5 millimeter lap) required 39 kilograms per square millimeter to part them. Tubes made from sheets with this solder can be drawn down on a mandrel.

"Aluminum-bronze castings can be united by the process known to foundrymen as sweating or burning. The parts to be joined are placed in a sand mold and an excess of hot metal flowed over the joint. When carefully done the joint can not be seen, and shows as great strength as the body of the casting. Thin cylinders may be made in this way by bending sheets and sweating their edges together."

Another formula for soldering, given by Mr. Dagger, which he found to give fairly good results, is, for ordinary work, an alloy of—aluminum, 6 parts; copper, 4; zinc, 90; but the zinc must be free from iron. For heavy soldering the proportions are—aluminum—12 parts; copper, 8, and zinc, 80.

Alloys.—In 1890 the Cowles Company produced 90,941 pounds of ferro-aluminum, containing about 12 per cent. of aluminum and 16,299 pounds of aluminum bronze.

In 1889 the total amount of aluminum alloys produced by this company was 171,759 pounds.

In recent experiments in Europe with aluminum bronze it is said that the alloy has shown itself well adapted for small arms using the new smokeless powders. Its use for ordnance was suggested in this country some three years ago by Mr. E. H. Cowles.

Experiments have recently been made at Calais, France, by the Department of Aërial Navigation with light aluminum alloys. A striking increase in tensile strength is noticeable on adding small quantities of copper to aluminum. The copper was added in the form of wire to the molten metal. As will be seen, the specific gravity of the alloy is not much greater than that of aluminum itself. The following table, from the London Engineer, gives the results of the experiments referred to:

Strength of alloys of aluminum and copper.

Composition.	Specific gravity.		Tons per square inch.
	Calculated.	Determined.	
Aluminum	....	2.67	12.0
Aluminum 98 per cent, copper 2 per cent	2.78	2.71	19.65
Aluminum 96 per cent, copper 4 per cent	2.90	2.77	19.9
Aluminum 94 per cent, copper 6 per cent	3.02	2.82	24.7
Aluminum 92 per cent, copper 8 per cent	3.14	2.86	22.7

The aluminum used was from the *Société de l'Aluminium*, and was very nearly pure.

The whole subject of aluminum alloys is being reopened by experiment. Since Deville's time there has been little occasion until recently to make and experiment with alloys of aluminum, or to determine the effect of alloying it with different proportions of a given metal. Aluminum bronze and, in a less degree, brass have become recognized as as valuable alloys, but there is apparently a field for experiment which is now being cultivated in many directions.

Besides the alloy of aluminum with silver for use in instruments mentioned above, another alloy of the metal has been made in this country, which is noticeable from a metallurgical standpoint, as well as on account of the peculiar properties of the alloy itself. This is an alloy of aluminum with titanium, which is made in the following way: It will be remembered that aluminum is produced at the Pittsburg Reduction Company's works by forming a fused bath of the fluorides of aluminum, sodium, and calcium, adding alumina thereto, and passing the current from a dynamo through the bath, by which the alumina is decomposed and aluminum is liberated. The alloy under consideration is made in an analogous manner. The fluoride bath is prepared by fusion in a carbon crucible, and either before or after fusion a reducible oxide or salt of titanium is added to it. Titanic oxide is the substance employed in practice. After thorough mixing has taken place, the titanic oxide being dissolved by the fluoride, aluminum is introduced, either in the molten state or solid. The titanic oxide is reduced, and the titanium alloys with the aluminum. The alloy is harder than aluminum, nearly as incorrodible, and, on hammering or rolling, acquires a degree of elasticity comparable to that of spring brass. For commercial uses an alloy containing from about one-half of 1 per cent to 2 per cent of titanium is best. An alloy of aluminum, titanium, and chromium, made in the same way, containing preferably less than 5 per cent of chromium, is also described. The chromium is added to give rigidity.

Metallurgical use.—In 1885, when the beneficial action of aluminum upon molten iron was first attracting attention, the statement was made that the melting point of the iron was very much lowered by adding aluminum to the bath. This statement was subsequently questioned, and has recently been answered definitely by a direct experiment described in a paper on aluminum steel, read before the Iron and Steel Institute at the New York meeting in 1890, by Mr. R. A. Hadfield. (Journal of the Iron and Steel Inst., No. II, 1890.)

A determination of the temperature of fusion, made with a Le Chatelier pyrometer by M. Osmond, of Paris, showed that the addition of 5 per cent of aluminum to steel does not lower the fusion point sensibly. Where there is an increase of fluidity in the metal after adding aluminum, Mr. Hadfield is inclined to attribute it to the evolution of heat due to the oxidation of the aluminum added, which takes oxygen from the iron oxide and carbonic oxide contained in the steel, rather than to any lowering of the melting point. From many considerations, Mr. Hadfield concludes that the action of aluminum on steel is like that of silicon, but is more energetic. Experiments cited in the paper referred to and in the discussion show that at a very high temperature aluminum is a powerful reducing agent, and will even decompose carbonic oxide, setting carbon free. It is possible that this deoxidizing power of aluminum may account in part, at any rate, for the prevention of blow-holes, which is a remarkable effect attributed to the addition of small quantities of the metal to iron or steel shortly before pouring. If carbonic oxide is contained or formed in the molten metal, it would escape before solidification, and so form blow-holes. But since aluminum decomposes it by depriving it of its oxygen, the evolution and escape of the gas would be prevented in proportion to the amount of aluminum acted on by it.

The following table shows the comparative physical properties of forged silicon and aluminum steels, both materials having been annealed. It is given by Mr. Hadfield to illustrate the similarity of the action of aluminum on steel to that of silicon:

Physical tests of silicon and aluminum steels.

	Per cent.			Limit of elasticity, in tons per square inch.	Breaking load, in tons per square inch.	Extension, per cent on 2 inches.	Reduction of area, per cent.	Bending test of annealed forged bars.
	Carbon.	Aluminum.	Silicon.					
Silicon steel A	.14	.24	......	15.17	25	37.55	60.74	Bent double cold.
Aluminum steel A	.15	......	.38	20	26	40.35	60.74	Do.
Silicon steel B	.18	.73	......	19	29.50	34.02	52.66	Do.
Aluminum steel C	.18	......	.66	18	27	33	52.14	Do.
Silicon steel C	.19	1.60	......	25	33	35	54.52	Do.
Aluminum steel F	.21	......	1.60	13	26	36.35	67	Do.
Silicon steel D	.20	2.18	......	25.50	34	36.50	59.96	Do.
Aluminum steel H	.24	......	2.24	18.50	28.50	33	48.62	Do.
Silicon steel H	.26	5.53	......	29	39	.70	2	Would not bend.
Aluminum steel I	.22	......	5.60	27	36	6.45	6.16	16°; broken.

Mr. Hadfield's main objection to the use of aluminum instead of silicon as a "physic" is its cost. He says:

"Speaking generally of the application of aluminum to the manufacture of iron and steel, the usual amount stated to be requisite for producing good results is about 0.10 per cent, but in many cases, as already pointed out, this would be too little. Supposing, however, that an average percentage of 0.10 or 0.15 per cent was necessary, and assuming the aluminum to be sold at $2 per pound, the expense of such addition would mean an extra cost of $4.50 and $7.25 per ton, respectively, whereas if as much as even 0.50 per cent of silicon is required to do the same work it does not cost more than $1.12 per ton."

Mr. Hadfield does not wish to disparage the efforts of those who have devoted so much time to the manufacture of aluminum by offering the above statement, but on the contrary expresses the hope that it may be an inducement to produce the metal more cheaply.

Aluminum imported and entered for consumption in the United States from 1870 to 1890.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
Fiscal years ending June 30—			Fiscal years ending June 30—		
1870	....	$98	1882	566.50	$6,459
1871	....	341	1883	426.25	5,079
1873	2.00	2	1884	595.00	8,416
1874	683.00	2,125	1885	439.00	4,736
1875	434.00	1,355	Calendar years—		
1876	189.00	1,412	1886	452.10	5,369
1877	131.00	1,551	1887	1,260.00	12,119
1878	251.00	2,978	1888	1,348.53	14,086
1879	284.44	3,423	1889	998.00	4,840
1880	340.75	4,042	1890	2,051.00	7,062
1881	517.10	6,071			

TIN.

In 1890 the Temescal mine in California made active preparations to produce pig tin. Production was begun early in the following year, when the mine was active. In South Dakota additional interest was directed to the mines of the Harney Peak Company by a visit of the directors, who ordered the construction of a large concentrating plant at Hill City. They decided upon the plans, let the contract for the work, and actual construction was promptly under way. In Virginia important steps were taken towards testing the richness of the Cash and adjacent mines in Rockbridge county. It is evident that the attention which has been lavished upon this comparatively humble metal has been fully sustained in 1889 and 1890. It will require years to decide whether tin mining will pay, but the condition of an actual product has been reached. It has been somewhat a matter of surprise that this product should come from developments in California, which are new compared to the better known operations in South Dakota. But this is simply the outcome of a different policy with the managers of the two enterprises. The deliberate progress in South Dakota, but involving a large investment, is offered as evidence of the owners' confidence in the final outcome. The rapid progress in California on a small scale is interpreted as a practical working test of the richness of the vein which has received the principal development. By this the new purchasers wish to ascertain the worth of the mineral portion of their investment. This investment includes a large agricultural tract, comprising the whole San Jacinto estate, and in which the tin mine is the least known feature. It is entirely possible for South Dakota to reach the position of a large producer as soon as California. The experience as to whether the ore will pay a satisfactory profit can not be gained, however, for years to come.

CENSUS STATISTICS.

The most quantitative and exact account of progress in this industry is that just published by the Eleventh Census, although the account by its brevity indicates very accurately the few items which could be posted in a ledger.

Tin statistics in the United States for the year 1889.

States.	Total output of tin-bearing rock. (Short tons.)	Total capital.	Total amount paid for wages.	Other expenditures.
California	5,000	$650,000	$18,464	$12,065
South Dakota	22,000	200,000	181,783	48,752
Virginia	1,000	48,000	1,800	....

Employés about tin mines in the United States in 1889.

States.	Number of openings.	Above ground.						Below ground.					
		Foremen.		Mechanics.		Laborers.		Foremen.		Miners.		Laborers.	
		Number.	Average wages.	Number.	Average wages.	Number.	Average wages.	Number.	Average wages.	Number.	Average wages.	Number.	Average wages.
California	6	2	$4.66	34	$3.30	31	$2.80	1	$6.46	9	$2.81	2	$2.14
South Dakota	621	8	4.39	28	8.25	49	2.50	5	3.60	132	3.00	8	2.50
Virginia	40	1	4.17	1	1.25	11	1.00	....	......	....	......	....	......
Wyoming (a)	11	....	......	....	......	....	......	....	......	....	......	....	......

a No work done in Wyoming in the census year.

This table shows that much substantial development work has been done on these various deposits. In all 6,000 feet of shafts and tunnels have been put in, besides 2,500 feet of open cuts. In the above statement of labor and wages no account is taken for the so-called assessment work done prior to patenting the claims, as this does not afford very definite employment, except to the few contractors for such work.

With regard to the present facilities for producing tin, it should be said that concentrating works are ready for operations at Glendale, South Dakota, and others have been ordered to be built at Hill City. At the Cash mine, in Virginia, a concentrator is to be built, and at the Temescal mines, in California, a small plant is in actual operation. There is a concentrator at the Etta mine, and the Tin Mountain Mining Company has a Cyclone pulverizer and other mining property.

RECENT DEVELOPMENTS.

South Dakota.—Since the report of 1888 the Burlington and Missouri River Railroad Company has extended its line through Custer, within a mile of Harney City, and directly through Hill City to Deadwood. At Hill City the concentrator of the Harney Peak Company is being erected. At this time (December, 1891) the frame work is nearly completed. In its arrangement the results of the Etta mill have been carefully studied. It is evident from these results that great care must be taken to save the finely-divided ore if the assay yields are to be approximated by the mill. The machinery will be placed as soon as the railroad spurs to the mill are ready. The company is arranging development work on a larger scale, and will have sunk 500 feet on the Addie by the spring of 1892. Other mines, including the old Etta, will be deepened.

California.—The plant of the San Jacinto estate, limited, consists of a large number of located tin veins and one, the Cajalco, on which considerable developments have been made, produced about 2,000 tons of ore were mined in 1890 and 1891, and which yielded in 1891 120,000 pounds, or 60 tons of metallic tin. The ore was concentrated and then smelted in a small furnace capable of reducing about a ton of metallic tin per twenty-four hours. In the summer of 1890 the concentrating plant was increased by adding pneumatic stamps, so that the mill has 50-stamp capacity or can handle 40 tons of rock in a regular day's work. Steps were taken toward building a dam in Temescal Creek which will furnish plenty of water for the mill, and is also designed to irrigate the agricultural lands of the estate. But the great freshets of 1890 destroyed the dam, which was not built on bed rock. This is now being explored preparatory to rebuilding.

Virginia.—In 1889 Mr. Moses Joy, jr., obtained the control of the Cash mine in Rockbridge County for a company principally of Boston capitalists. The visit of a thoroughly reliable mining engineer to the property in the spring of 1890 gave a much better outlook for the property than it had ever had before, and steps were at once taken to erect a small concentrating plant, a Sturtevant mill, and a vanner. At the close of 1891 this mill is ready for operations near Vesuvius Station on the Shenandoah Valley Railroad, as soon as the bad roads to the ore piles have been improved. It is also the policy of the company not to concentrate any ore until full possession of the mine is secured. The development work has put more than 2,000 tons of ore on the dumps ready to be handled to the concentrator.

Foreign tin mines.—The foreign sources have contributed the usual proportions of the total supply, as follows:

World's supply of tin from 1880 to 1890.

Years.	English production.	Straits shipments to Europe and America.	Australian shipments to Europe and America.	Banca sales in Holland.	Billeton sales in Java.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1880	8,918	11,735	9,177	3,756	4,735	38,321
1881	8,615	11,400	10,100	4,548	4,740	39,403
1882	9,300	11,705	10,067	4,399	4,200	39,671
1883	9,307	16,958	11,121	4,203	4,157	45,746
1884	9,574	17,548	9,337	4,193	3,600	44,252
1885	9,331	17,320	9,088	4,200	3,760	43,699
1886	9,312	19,674	8,064	4,379	4,128	45,557
1887	9,282	23,977	7,750	4,384	4,978	50,371
1888	9,241	23,855	7,975	4,430	5,220	50,721
1889	8,912	28,295	6,800	4,114	4,857	52,978
1890	9,000	27,470	6,415	5,317	5,232	53,434

There have been few novel developments in the last two years. According to the official reports, the Australian tin placers have grown steadily poorer and the Straits Settlements, with Banca and Billeton, have kept steadily on, with an occasional addition of a new placer. The mines of Siak have been well described by Mr. Charles M. Rolker in a paper published in the Transactions of the American Institute of Mining Engineers and of which a résumé is also published in the Census report. The paper makes a valuable contribution to the meager literature of the tin deposits of the East and is very instructive, particularly as to the labor difficulties in that region.

Imports and exports.—The following tables show the tin and tin plates imported and entered for consumption from 1867 to 1890; also the value of the exports of the manufactures of tin from 1826 to 1890:

Tin and tin plates imported and entered for consumption in the United States, 1867 to 1890.

[Calendar years ending December 31, from 1886 to 1890; previous years ended June 30.]

Years.	In blocks, bars, or pigs, and grain tin.		Tin plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Cwts.		*Cwts.*		
1867	....	$1,210,354.02	....	$6,276,136.78	$7,486,490.80
1868	....	1,454,327.36	....	6,893,072.07	8,347,399.43
1869	80,811	1,709,385.00	1,534,324	8,565,432.56	10,274,817.56
1870	81,702	2,042,887.71	1,333,150	7,628,871.51	9,671,759.22
1871	106,595	2,938,409.82	1,556,023	9,490,778.64	12,429,188.46
1872	102,006	3,033,837.45	1,617,627	10,736,906.59	13,770,744.04
1873	130,469	3,938,032.25	1,854,956	15,906,446.82	19,844,479.07
1874	116,442	3,199,807.07	1,553,860	13,322,976.14	16,522,783.21
1875	102,904	2,329,487.96	1,540,600	12,557,630.75	14,887,118.71
1876	93,176	1,816,506.00	1,767,210	10,226,802.87	12,043,308.87
1877	98,209	1,783,765.00	1,984,893	9,818,069.69	11,601,834.69
1878	128,849	2,167,350.00	2,166,489	9,893,639.61	12,060,989.61
1879	142,927	2,301,944.00	2,487,007	10,248,720.34	12,550,664.34
1880	290,007	6,153,005.68	3,298,534	16,524,590.19	22,677,595.87
1881	171,146	3,971,756.67	3,366,720	14,641,057.87	18,612,814,54
1882	197,544	5,204,251.68	3,926,811	16,550,834.64	21,755,086.32
1883	237,348	6,106,250.37	4,051,108	16,688,276.67	22,794,527.04
1884	(a)26,081,992	5,429,184.01	(a) 527,881,321	18,931,072.70	24,360,256.71
1885	23,947,523	4,263,447.00	505,559,076	16,610,104.56	20,873,552.00
1886	27,960,768	5,873,773.00	574,098,405	17,719,957.12	23,593,730.12
1887	29,645,531	6,927,710.00	570,643,389	16,883,813.95	23,811,523.95
1888	31,740,583	8,758,562.00	632,224,296	19,034,821.03	27,793,383.03
1889	35,177,646	7,045,939.00	734,086,964	20,361,564.00	27,407,503.00
1890	33,800,729	6,869,645.00	688,247,657	21,923,754.00	28,793,399.00

a Pounds in 1884 and following years.

Value of tin manufactures exported from the United States (a).

[Fiscal years ending September 30 until 1843; ending June 30, from 1844 to 1886; calendar years since 1886.]

Years.	Value.	Years.	Value.	Years.	Value.
1826	$4,515	1848	$12,853	1870	$46,007
1827	2,967	1849	13,143	1871	70,866
1828	5,049	1850	13,590	1872	67,244
1829	1,757	1851	27,823	1873	69,865
1830	4,497	1852	23,420	1874	62,973
1831	3,909	1853	22,988	1875	48,194
1832	3,157	1854	30,698	1876	48,144
1833	2,928	1855	14,279	1877	87,057
1834	2,230	1856	13,610	1878	116,274
1835	2,545	1857	5,622	1879	103,467
1836	5,604	1858	24,186	1880	144,185
1837	10,892	1859	39,289	1881	498,524
1838	10,179	1860	39,064	1882	198,608
1839	19,981	1861	30,229	1883	191,947
1840	7,501	1862	62,286	1884	166,819
1841	3,751	1863	41,558	1885	162,304
1842	5,682	1864	46,968	1886	157,724
1843 (nine months)	5,026	1865	106,244	1887	137,551
1844	6,421	1866	79,461	1888	219,000
1845	10,114	1867	40,642	1889	255,100
1846	8,902	1868	27,110	1890	262,343
1847	6,363	1869	18,994		

a Classed as "tin, and manufactures of," from 1851.

Prices.—There have been no great fluctuations in prices in the past two years similar to those in 1888, due to the operations of the French copper syndicate. In 1889 the price was comparatively steady, fluctuating by fractions of a cent from 21 cents per pound. In 1890 the prices were not so steady, the principal feature being a rise in September to 25 cents per pound. This soon declined again to 21 cents, which was about the average for the year. The rise in price was due to a speculative movement, and the corner was aided by comparatively light stocks in New York and good consumptive demand. In 1891 the prices ruled slightly lower without great fluctuations, except a rise to 21½ cents in June. The prices for recent years are given below:

Prices of tin in New York by months from 1885 to 1891.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1885	16⅝	17.45	17⅝	17.80	18⅛	20⅜	22⅜	21½	20.95	20.95	20.65	21.00
1886	20⅝	20.70	20.80	20.85	21.30	22¾	22¼	21¾	22.20	22¼	22.40	22¼
1887	20.30	22⅛	22.55	22¼	22.95	23½	23.35	23.30	23⅛	25⅝	31.05	36⅛
1888	36.95	36.95	36.70	32.95	21.95	18.05	19½	20¼	22.95	23.35	22.70	22.10
1889	21⅛	21⅛	21.30	20⅞	20⅛	20.30	19⅞	20.20	21.30	20.80	21¾	21.30
1890	20.95	20.87	20.89	20.13	21.52	21.53	21.17	21.62	24.00	22.60	21.07	21.21
1891	20.20	19.90	19½	19⅛	20.00	21.00	20.20	20.10	20½	20.10	20.00	19.90

NICKEL AND COBALT.

During 1889 and 1890 nickel mining was depressed in the United States by the developments in Canada, but prospecting for nickel ores was active from the prominence which was given to the metal as an addition to steel. The product of the mines of the United States, together with the foreign ores smelted in the United States, was 252,663 pounds in 1889. In 1890 it was 223,488 pounds. The price did not vary markedly, hence the total values for the years were proportionate—$151,598 in 1889 and $134,092 in 1890. The United States' product in both years came from Lancaster Gap, Pennsylvania; Mine La Motte, Missouri, and Lovelock's, Nevada.

Early in 1891 the Lancaster Gap mine was shut down on account of Canadian competition.

Product of the United States, 1876 to 1890.

Years.	Metallic nickel.	Nickel in matte.	Nickel in ore.	Nickel in nickelammonium sulphate.	Total.	Value.
	Pounds.	*Pounds.*	*Pounds.*	*Ponnds.*	*Pounds.*	
1876	....	....	....	....	201,367	$523,554
1877	....	....	....	....	188,211	301,138
1878	....	....	....	....	150,890	165,979
1879	....	....	....	....	145,120	162,534
1880	....	....	....	....	233,893	257,282
1881	....	....	....	....	265,668	292,235
1882	277,034	4,582	....	....	281,616	309,777
1883	6,500	52,300	....	....	58,800	52,920
1884	....	64,550	....	....	64,550	48,412
1885	245,504	14,400	18,000	....	277,904	179,975
1886	182,345	20,000	5,600	7,047	214,992	127,157
1887	183,125	10,846	....	11,595	205,566	133,200
1888	190,637	....	1,000	12,691	204,328	127,632
1889	209,763	42,900	....	....	252,663	151,598
1890	223,488	....	....	....	223,488	134,092

The product of cobalt oxide has been as follows: In 1889 it was 12,955 pounds, valued at $32,388; and in 1890, 6,788 pounds, worth, at $2.40 per pound, $16,291.

The total product of cobalt oxide in late years is given in the following table:

Production of cobalt oxide in the United States.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
1869	811	1877	7,328	1885	8,423
1870	3,854	1878	4,508	1886	8,689
1871	5,086	1879	4,376	1887	5,769
1872	5,749	1880	7,251	1888	7,491
1873	5,128	1881	8,280	1889	12,955
1874	4,145	1882	11,653	1890	6,788
1875	3,441	1883	1,096		
1876	5,162	1884	2,000		

The closure of the Gap nickel mine in 1891 will result in a smaller product in the future.

The importations have increased markedly in the last two years. They have been as follows:

Cobalt oxide imported and entered for consumption in the United States, 1868 to 1890

Years ending—	Oxide.		Years ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
June 30—	*Pounds.*		June 30—	*Pounds.*	
1868		$7,208	1880	9,819	$18,457
1869		2,330	1881	21,844	13,837
1870		5,019	1882	17,758	12,764
1871		2,766	1883	13,067	22,323
1872		1,920	1884	25,968	43,611
1873	1,480	4,714	1885	16,162	28,138
1874	1,404	5,500	1886	19,366	29,543
1875	678	2,604	December 31—		
1876	4,440	11,180	1887	26,882	39,396
1877	19,752	11,056	1888	27,446	46,211
1878	2,860	8,693	1889	41,455	82,332
1879	7,531	15,208	1890	33,338	63,202

Census statistics.—The inquiry into the personnel of the nickel mining industry in 1889 shows that 187 persons are employed. The wages received by them averaged $3.30 per day for the foreman underground and $2.61 for foremen on the surface. Miners received $2.45. Employment was comparatively steady during the year. The total paid in wages to the employés amounted to $84,200. This included a large amount of unproductive prospecting and development work in Nevada, so that the total received for the 1,151 tons of matte showed a net loss. The mining inquiry of the Census Office did not include the smelting of this matte.

No new deposits of proved value have been found in the United States since the last report, although finds have been noted in North Carolina, the Black Hills of South Dakota, and in Idaho; the Gem mine in Fremont County, Colorado, was also developed slightly. The peculiar arsenide deposits of Nevada have been explored quite thoroughly, and a valuable description was published of these deposits in the census report.

The Canadian mines described in 1888 report continue as the chief factor in the supply in this part of the world. They are located near Sudbury along the Sault Ste. Marie branch of the Canadian Pacific Railway. Here the Canadian Copper Company has opened three mines, the Stobie, Evans, and Copper Cliff (with two water-jacketed furnaces); and the Dominion Copper Company has the Blezard, Worthington, and Crean; and Sir H. H. Vivian owns the Murray mine, 2½ miles northwest of Sudbury. This Vivian mine and the Dominion Company have each a water-jacketed furnace. The total yield of metallic nickel from these mines in 1889 was 2,500,000 pounds of nickel contained in the matte, which formed the article of export, and in 1890, 1,336,627 pounds.

The New Caledonia mines, which have been described frequently, still furnish a large proportion of the world's supply, although the deposits are pockets of uncertain extent. The output in 1890 included about 5,000 tons of garnierite and 700 tons of manganiferous iron ore containing cobalt. The cost of mining is considerable, the labor uncertain, and the transportation facilities poor. Lately manganiferous iron ores, containing about 3 per cent. of cobalt oxide and perhaps 2 per cent. of nickel, have been sent to Rouen and there parted.

Imports.—The following table shows the imports of nickel into the United States from 1868 to 1890.

Nickel imported and entered for consumption in the United States, 1868 to 1890, inclusive.

Calendar years ending December 31 since 1886; previous years end June 30.	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1868		$118,058			$118,058
1869		134,827			134,827
1870		99,111			99,111
1871	17,701	48,133	4,438	$3,911	52,044
1872	26,140	27,144			27,144
1873	2,842	4,717			4,717
1874	3,172	5,883			5,883
1875	1,255	3,157	12	36	3,193
1876			156	10	10
1877	5,978	9,522	716	824	10,346
1878	7,486	8,837	8,518	7,847	16,684
1879	10,496	7,829	8,314	5,570	13,399
1880	38,276	25,758	61,869	40,311	66,069
1881	17,983	14,503	135,744	107,627	122,130
1882	22,906	17,924	177,822	125,736	143,660
1883	19,015	13,098	161,159	119,386	132,484
1884			(*a*) 194,711	129,733	129,733
1885			105,603	64,166	64,166
1886			277,112	141,546	(*b*) 141,546
1887			439,037	205,232	(*c*) 205,232
1888			316,895	138,290	(*d*) 138,290
1889			367,288	156,331	(*e*) 156,331
1890	(*f*) 566,571	260,665	247,299	115,614	376,279

a Including metallic nickel.
b Including $465 worth of manufactured nickel.
c Including $879 worth of manufactured nickel.
d Including $2,281 worth of manufactured nickel.
e Including $131 worth of manufactured nickel.
f Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.

Value of exports of nickel and nickel ore of domestic production from the United States.

Calendar years ending December 31 since 1886; previous years end June 30.	Manufactured nickel.	Nickel coin.	Nickel ore.
1864			$25,494
1865			36,710
1869			11,350
1872			43,500
1873	$19,780		19,891
1874	16,062		75,696
1875	26,000		72,020
1876	168,050		35,100
1877	8,200		
1878			2,452
1880	4,120		
1881	6,600	$32,880	
1882	12,474	7,200	
1883	9,911		*a* 12,182
1884			*a* 22,249
1885	1,223		10,500
1886	45,653		5,700
1887	89,209		7,500
1888	38,951		625
1889	100		
1890	446		25

a Classed as "nickel and cobalt ore."

MANGANESE.

By Joseph D. Weeks.

The ores of manganese are divided into four general classes in the present report: (1) Manganese ores; (2) manganiferous iron ores; (3) manganiferous silver ores; and (4) manganiferous zinc ores. The dividing line between the first two grades is taken at 70 per cent. of manganese dioxide, or 44.252 per cent. of metallic manganese; those containing less manganese, containing also more or less iron, are classed as manganiferous iron ores. In the third class are included the argentiferous manganese ores of Colorado, which are utilized chiefly for the silver they contain, while the fourth class includes only the manganiferous residuum from New Jersey zinc ores.

The long ton of 2,240 pounds is used in this report.

Product of manganese ores.—In 1889 the product of manganese ores proper aggregated 24,197 tons, worth $240,559. This was obtained as in previous years principally from Crimora, Virginia, Cartersville, Georgia, and Batesville, Arkansas. In 1890, however, 6,397 tons were obtained from Colorado.

Amount and value of manganese ores produced in the United States in 1889 and 1890.

States.	1889.			1890.		
	Production.	Total value.	Value per ton.	Production.	Total value.	Value per ton.
	Long tons.			*Long tonr.*		
Arkansas	2,528	$23,173	$9.17	5,339	$59,861	$11.21
California	53	901	17.00	386	3,176	8.23
Colorado	....	....	....	6,397	25,588	4.00
Georgia	5,208	50,143	9.63	749	4,920	6.57
Nevada	15	83	5.53	100	300	3.00
North Carolina	47	470	10.00	14	84	6.00
South Carolina	124	744	6.00	....	....	....
Tennessee	30	120	4.00	....	....	....
Vermont	1,576	8,668	5.50	....	....	....
Virginia	14,616	156,257	10.69	12,699	125,121	9.85
Total	24,197	240,559	(*a*) 9.94	25,684	219,050	(*a*) 8.53

a Average.

In but four instances at the most is manganese ore mining prosecuted in the United States with anything like regularity, and in but two of the four is mining continuous. At the works producing the largest amount of manganese in Georgia the mines were operated but one hundred and ninety days in the year 1889, while at the Vermont mine during a large proportion of the year but little work was done. At one mine in Virginia and one in Arkansas the mining of manganese is fairly continuous. At most of the other works the production reported has been from very irregular workings, and chiefly for the purpose of testing the character of the deposit. This is true of all the production of Tennessee, North Carolina, South Carolina, and Nevada, while the California production is from an old mine, worked occasionally to meet a small demand for manganese for the purpose of making chlorine gas in working sulphuret ores. The employés are in most cases men who were employed for a very brief time, and who were in most instances common laborers picked up from farm and other work, returning to their ordinary occupations as soon as their temporary service in stripping manganese ore deposits and in mining the small quantities of manganese reported were completed.

Production of manganese ores in the United States.

States.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
Virginia	3,661	3,295	2,982	5,355	8,980	18,745	20,567	19,835	17,646	14,616	12,699
Arkansas	....	100	175	400	800	1,483	3,316	5,651	4,312	2,528	5,339
Georgia	1,800	1,200	1,000	....	....	2,580	6,041	9,024	5,568	5,208	749
Other States...	300	300	375	400	400	450	269	14	1,672	1,845	6,897
Total	5,761	4,895	4,532	6,155	10,180	23,258	30.193	34,524	29,198	24,197	25,684

Product of manganiferous iron ores.—A large proportion of the hematite iron ores of the United States carry more or less manganese. While in most cases the amount of manganese in these ores does not increase their value over what the same ores would be worth as iron ores were the manganese absent, they, however, make the ore more desirable for certain purposes. No attempt has been made to collect the statistics of these manganese-bearing iron ores except in cases where the manganese in them has added somewhat to their value.

A product of 31,341 tons of ore, containing on an average 9 per cent. manganese, is reported from Michigan for 1889, and a further product of 50,018 tons of ore, containing 6.74 per cent. of manganese, is reported for the same State, making a total of 81,359 tons of iron ore produced in Michigan, containing sufficient manganese to make it desirable to be mined. The value of this ore is reported at $4.54 a ton. In 1890 the total product was 61,863 tons, and the value $231,655.

Product of manganiferous silver ores.—Returns of the production of 17,550 tons of manganese-bearing silver ores have been received for 1889 and 51,840 tons for 1890, all from Colorado. The manganese in these ores makes them desirable as fluxes.

Nearly all the argentiferous iron ores mined from the upper workings of the Leadville deposits carry manganese in varying quantities from 5 up to 25 per cent. and occasionally 30 to 35 per cent., with 5 to 20 ounces of silver, 0 to 4 per cent. of lead, 7 to 18 per cent. in silica, and 30 to 50 per cent. of iron. It has been estimated that from 300 to 500 tons of this ore are produced per day. On the basis of the lowest figures—that is, 300 tons a day for 300 days in the year—the production of argentiferous manganese ore in the Leadville district would be 90,000 tons; but, as stated above, the total detailed reports received of this production are for only 17,550 tons.

These ores are sold to the smelters for fluxing the siliceous silver ores, and are usually paid for according to the silver contents—that is, so much per ounce of silver, without reference to the manganese contained therein. In some cases the value of this ore has been placed at $3.50 a ton for its contents of iron and manganese.

Product of manganiferous silver ores in the United States in 1889 and 1890.

	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Colorado, 20 per cent of manganese and over	9,987	$227,455	7,826	$27,391
Colorado, less than 20 per cent of manganese	55,000		44,014	154,049
Total	64,987	227,455	51,840	181,440

Product of manganiferous zinc ores in the United States in 1889 and 1890.

Years.	Quantity.	Value.
	Long tons.	
1889	43,648	$54,560
1890	48,560	60,700

Total product of all kinds of manganese ores in the United States in 1889 and 1890.

	1889.			1890.		
	Quantity.	Value.	Value per ton.	Quantity.	Value.	Value per ton.
Manganese ores	24,197	$240,559	$9.94	25,684	$219,050	$8.53
Manganiferous iron ores	83,434	271,680	3.26	61,863	231,655	[illegible]
Manganiferous silver ores	64,987	227,455	3.50	51,840	181,440	3.50
Manganiferous zinc ores	43,648	54,560	1.25	48,560	60,700	1.25
Total	216,266	794,254	3.67	187,947	692,845	3.69

Manganese imported and entered for consumption into the United States in 1889 and 1890.

Years.	Ore.		Oxide of.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1889	4,135	$72,391	151	$6,000
1890	33,998	509,704	156	7,196

THE WORLD'S PRODUCTION OF MANGANESE.

The following table exhibits an estimate of the world's product in 1888 and 1889. Where the figures are not obtainable for either of these years the latest available statistics are given, and are regarded as approximately the annual product:

Total product of manganese in the world in 1888 and 1889.

Countries,	1888.	1889.	Countries.	1888.	1889.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Caucasus (Russia)	48,653	60,000	Greece	385	400
United States	29,198	24,197	Italy	1,652	400
Chile	24,746	5,000	Cuba	1,581	4,000
France (1886)	7,676	....	Other countries	3,114	1,000
Sweden	6,089	18,000	Nova Scotia	106	200
Portugal	5,638		New Brunswick	1,094	1,000
Spain	2,830		Quebec	3	....
Australia	1,572	9,000	Great Britain (1887)	13,054	10,000
New Zealand	787	....	Bosnia	4,000	2,000
Turkey	669	8,000	Holland	1,107	800

ARKANSAS.

Manganese ores are found in two localities in Arkansas; one covering portions of Independence and Izard counties, in the northeastern part of the State, and known as the Batesville region; the other in the southwestern portion and extending from Pulaski county on the east to Polk county and the Indian Territory on the west. The Batesville region has produced all the ores mined commercially in the State. What little work has been done in the other district has been principally in the way of development.

The production of manganese in Arkansas since the beginning of shipments in 1850, as far as can be ascertained, is shown in the following table. The authorities for the figures are quoted in each instance. It has been estimated that the total production of manganese in Arkansas from 1850 to 1885 amounted to 5,000 tons, but this is probably exaggerated. The product from 1881 to 1884, inclusive, has been obtained from the railroad reports of shipments and may be considered fairly reliable. From 1885 to 1888 and for 1890 the statistics were collected for Mineral Resources of the United States, while those for 1889 are from the mineral volume of the Eleventh Census. The figures from 1885 to 1890 have been verified by statements of shipments kindly furnished by the officers of the St. Louis, Iron Mountain and Southern railroad.

Production of manganese in the Batesville district of Arkansas to December 31, 1890.

Years.	Authority.	Tons.
1850 to 1867	Estimated	400
1868	......do	10
1881	Railroad reports of shipments	100
1882	......do	175
1883	......do	400
1884	......do	800
1885	Mineral Resources of the United States	1,483
1886	......do	3,316
1887	......do	5,651
1888	......do	4,312
1889	Census	2,528
1890	Mineral Resources of the United States	5,339

Product of manganese ores in Arkansas, from 1880 to 1890.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1880		1886	3,316
1881	100	1887	5,651
1882	175	1888	4,312
1883	400	1889	2,528
1884	800	1890	5,889
1885	1,483		

CALIFORNIA.

The first mining of manganese in California is reported to have been done in 1867 by Mr. A. S. Ladd, at Corral Hollow, in Alameda county. This was carried on until 1874, the ore, which is said to have amounted in all to about 5,000 tons, being shipped to England for use in chemical manufacture. Since 1874 Spanish manganese has supplanted the California product in England, and this market for the latter being closed the production has been small. The Ladd mine was sold in 1874 to Mr. Justinian Caire, who produces a small amount each year, the product for 1889 being 53 tons, worth about $17 per ton. The ore runs from 56 to 72 per cent. pyrolusite; and when fresh is a hard, black, massive variety, occurring in a lenticular bed, interstratified in red, yellow, and gray jasper. In 1890 the product increased to 386 tons, but decreased in the price per ton to $8.23.

Regarding the total product of the State, little can be said and still less can be authoritatively stated regarding the annual product in each year. A prominent dealer on the coast reports, as published in the Mineral Resources of the United States, 1886, that the total amount used in California was from 100 to 150 tons annually. The price is said to have been $3 to $4 per ton at the mine for ore carrying from 50 to 60 per cent. manganese. The price quoted for the product in 1889 was for ore delivered in San Francisco. If, as is stated above, 5,000 tons of ore were mined in California up to 1874, it is possible that between 6,000 and 6,500 tons of manganese may have been produced in the State from the beginning of mining.

An analysis of the manganese from the Corral Hollow mine is as follows:

Analysis of manganese from Corral Hollow, California.

	Per cent.
Manganese protoxide (MnO)	75.26
Oxygen (O)	6.94
Ferric oxide (Fe_2O_3)	3.26
Cobalt oxide (CoO)	Trace
Lime (CaO)	3.10
Baryta (BaO)	None
Magnesia (MgO)	0.56
Potash (K_2O)	0.19
Soda (Na_2O)	0.58
Water (H_2O)	8.46
Silica (SiO_2)	1.98
Total	100.33

Other deposits of manganese are known to exist in California, but they are at present of no commercial importance.

COLORADO.

Colorado produces two classes of manganese-bearing ores, a manganiferous iron ore, used to some extent in the production of spiegeleisen, and a manganiferous silver ore, used as a flux in the smelting of silver-lead ores. The manganiferous iron ores carry, as a rule, but little silver, though in some cases the content of silver has been so high as to justify the working for silver of the slags produced at the blast furnaces at the time they were running on spiegeleisen.

These ores are all from the upper workings of the Leadville silver deposits, and carry manganese in varying quantities, from 5 up to 25 per cent., and occasionally 30 to 35 per cent., with 0 to 20 ounces of silver, 0 to 4 per cent. of lead, 7 to 18 per cent. in silica, and 30 to 50 per cent. of iron.

As stated above, those high in manganese and low in silver are sold to steel works for the manufacture of spiegeleisen, while those carrying silver and not too high in silica are sold to the silver smelters and paid for according to the content of silver. It is usual for the smelters to buy these ores according to their so-called "silica excess"—that is, the excess of iron and manganese over silica. This "silica excess" was placed in 1889 at 40 per cent—that is, there must be an excess of 40 per cent of manganese and iron over the silica in the ore, and it is then accepted and paid for, not according to its iron and manganese contents, but its silver. When the "excess" is above 40 per cent. the excess is paid for at 10 cents a unit. Thus, an ore with the following composition: metallic manganese, 25 per cent.; metallic iron, 30 per cent.; silica, 2.5 per cent., and silver, 5 ounces, would have an excess of iron over silica of 52.5 per cent., or 12.5 per cent. above the 40 per cent. minimum excess. This, at 10 cents a unit, would be $1.25; the 5 ounces of silver, at 45 cents an ounce, would be $2.25, and the ore would be worth $3.50. It will not pay to produce these ores at less than $3.50, free on board at mines.

It has been estimated that from 300 to 500 tons of this ore are produced per day. On the basis of the lowest figures—that is, 300 tons a day for 300 days in the year—the production of manganiferous silver-iron ore in the Leadville district would be 90,000 tons.

The actual shipments to spiegel furnaces in 1889 were 2,075 long tons. It is estimated that in addition to this 9,987 tons, containing over 20 per cent of maganese, were sold as flux ores, and returns of the sales of some 55,000 tons of flux ores carrying less than 20 per cent of manganese have been received. This would make the production in 1889 as follows:

Production of manganiferous ores in Colorado in 1889.

	1889.	1890.
	Long tons.	*Long tons.*
Manganiferous iron ores used for spiegeleisen	2,075	
Manganiferous silver ores, with 20 per cent and over of manganese	9,987	7,826
Manganiferous silver ores, with less than 20 per cent of manganese	55,000	44,014
Total	67,062	51,840

As these ores were not produced as manganese ores, no returns of capital, employés, etc., can be given. Analyses of these ores carrying 20 per cent. and over of manganese are as follows:

Analyses of manganiferous iron ores in Colorado.

Component parts.	Catalpa.	Cresent No. 1.	Crescent No. 2.	Hull.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Iron	34.90	17.80	21.15	35.00
Silica	6.90	6.30	7.00	3.83
Manganese	21.30	34.00	31.00	19.30
Alumina	4.15			2.00
Lime	0.34			0.46
Magnesia	0.07			0.45
Sulphur	0.06	0.027		
Phosphorus	0.04	0.056		
Copper	Trace.			0.03
Oxide of lead				1.85
Volatile matter				9.86
Water				2.96

GEORGIA.

Near Cartersville, Georgia, is one of the oldest manganese ore-producing districts in the country. It is also one which has been most continuously worked. Mining was begun at this locality in 1866 by the Pyrolusite Mining Company, and 550 tons of ore were mined and sold in that year. The deposits are in the northwestern part of the State, in Bartow county, extending into Cherokee county. Other deposits have also been found in the extreme northwestern part of the State, in what is known as the Cave Spring district, but the product is almost entirely from the Cartersville region.

The production of manganese ore in Georgia has varied greatly, increasing nearly 100 per cent. from 1885 to 1886, or from 2,580 to 5,981 tons; nearly the same rate of increase is shown in the product for 1887, or to 9,024 tons. In 1888, it decreased to less than in 1886, and 360 tons more in 1889, the product for the two years being, respectively, 5,568 and 5,208 tons. In 1890 the product fell off to less than any year since 1866, being only 749 tons. The following table shows the annual production of manganese ores in Georgia so far as ascertained:

Production of manganese ore in Georgia from 1866 to 1890, inclusive.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1866	550	1879	2,400
1867	5,000	1880	1,800
1868		1881	1,200
1869		1882	1,000
1870		1883	....
1871		1884	....
1872		1885	2,580
1873		1886	5,981
1874	2,400	1887	9,024
1875	2,400	1888	5,508
1876	2,400	1889	8,208
1877	2,400	1890	749
1878	2,400		

NEVADA.

A small amount of manganese has been produced in Nevada, near Golconda, on the Central Pacific railroad. The product in 1889 was 15 tons, worth $83. In 1890 the product increased to 100 tons, worth $300.

NORTH CAROLINA.

Frequent reports are made of discoveries of manganese ore in North Carolina, but up to the present time it has not been found in paying quantities. The amounts reported as being mined in this State have been only for experimental purposes. In 1889 the product was 47 tons, valued at $10 per ton, and in 1890, 14 tons, valued at $6 per ton. The product since 1886 has been as follows:

Production of manganese in North Carolina from 1886 to 1890, inclusive.

Years.	Tons.
1886	15
1887	14
1888	50
1889	47
1890	14

SOUTH CAROLINA.

Very little manganese has been mined in South Carolina, though no doubt deposits exist here as they do in North Carolina. The only deposit that has been worked, so far as ascertained, is ont he Dorn lands, near McCormick, and is owned by the Manganese Mining Company. Mining was begun in 1885 and continued until 1889. No product is reported for 1890.

The total production of manganese ore in South Carolina, so far as the same has been ascertained, is as follows:

Total production of manganese ore in South Carolina.

Years.	Tons.
1885 and 1886	300
1887	45
1888	50
1889	124

TENNESSEE.

So far as has been learned, the first manganese produced in the United States was in 1837, near Whitfield, Hickman county, Tennessee. It was for use in coloring earthenware, and it has been used for this purpose continuously ever since. The product, however, has been but a few hundred pounds each year. Exclusive of this small annual product in Hickman county, the product of Tennessee has amounted to 96 tons. This is since 1886, when the first is reported. No product is reported for 1887 or 1890.

Total production of manganese ore in Tennessee.

Years.	Tons.
1886	50
1887	......
1888	16
1889	30
1890	......

VERMONT.

According to Hitchcock's Geology of Vermont, manganese ore had been shipped from Brandon and Chittenden to England, but no reliable reports of actual production are obtainable for any year previous to 1888. The product for 1888 is given at 1,000 tons. Messrs. Carnegie Brothers & Co., limited, operated the Brandon deposits in 1889 and produced 1,576 tons, but abandoned them in 1890 and no ore was mined in that year.

VIRGINIA.

The production of manganese in Virginia in 1889 was 14,616 tons, valued at $156,257. This was considerably more than half the product of the entire country. In 1890 the production decreased 1,917 tons, being 12,699 tons, worth $125,121, and a little less than half the entire product reported for that year. The product in this State has shown a steady decrease since 1886, in which year it reached its maximum figure. The production of manganese in Virginia since 1880 has been as follows:

Production of manganese in Virginia from 1880 to 1890, inclusive.

Years.	Tons.
1880	3,061
1881	3,295
1882	2,982
1883	5,355
1884	8,980
1885	18,745
1886	20,567
1887	19,835
1888	17,646
1889	14,616
1890	12,699

So far as explorations have been made, manganese ores have been found over a much greater extent of territory in Virginia than in any other State. It is uncertain what future development may disclose in other States, but at present Virginia has more known deposits of this mineral. More localities have been worked and more manganese produced, and yet there were but two localities in 1889 and 1890 which produced any considerable amount. These are the Crimora and Houston mines. A small amount of high-grade pyrolusite, used in the manufacture of glass and bromine, was shipped from the Leets or Lerner mine, at Mount Athos. The three mines mentioned are the only ones producing regularly in the State. The Crimora and Houston are decreasing in production.

CHROMIC IRON ORE.

In 1889 and 1890 the same desultory mining of chrome iron ore which has been reported in previous volumes continued. Notices of deposits continue to be made in North Carolina and Georgia, but shipments came only from California. In 1889, 2,000 long tons, worth in San Francisco $30,000, were produced, and 3,599 tons in 1890, worth $53,985. The annual product since 1880 is as follows:

Production of chromic iron ore in the United States.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Long tons.			*Long tons.*	
1880	2,288	$27,808	1886	2,000	$30,000
1881	2,000	30,000	1887	3,000	40,000
1882	2,500	50,000	1888	1,500	20,000
1882	3,000	60,000	1889	2,000	30,000
1884	2,000	35,000	1890	3,599	53,985
1885	2,700	40,000			

The production of chromic iron ore in California during 1890 and 1891 has been as follows:

Production of chromic iron ore in California in 1890 and 1891, by counties.

Counties.	1890.	1891.
	Long tons.	*Long tons.*
Alameda	355	229
San Luis Obispo	687	74
Tehama	2,207	1,069
Placer	150	....
Shasta	200	....
Total	3,599	1,372

Mr. C. C. Darwin, of the Geological Survey, while engaged in other work on the Pacific coast, has visited the scattered localities where chromic iron ore is produced, and states that there is no mining of the ore properly speaking and no company or combination of men operating in any one place. The ore is quarried out in dull times by land owners who have found pockets of it, reported it to interested parties, and been furnished by these parties with the capital needed to break it out and pile it up for transportation. In most cases the work is done only in the intervals of farming, and the owner gets only a royalty on every ton of sufficiently high grade ore. While there are outcroppings of the ore in the serpentine all along the foothills of the Sierras, most of it contains less than 47.5 per cent. of Cr_2O_3 and has at present no commercial value, and the richer ore deposits are in localities so inaccessible that the cost of getting it to railroad station or seaport consumes all the profit that could be made upon it. The experience of the men handling the chromic ores on the Pacific coast shows that no ore grading less than 50 per cent. can be got to San Francisco, shipped even at ballast rates around the Horn to Philadelphia or Baltimore, and pay the cost of handling it in competition with the ores from the Mediterranean.

Wherever found it has been in pockets that are sooner or later exhausted, so that, even in the most promising finds, the policy of constructing roads over which to haul it can not be determined until the contents of the pocket have been broken out and estimated. There are many dumps in San Luis Obispo county and in Del Norte which have been owned for years by brokers who found the ore of good quality and purchased it, but have never marketed it because the quantity in any one place will not at present prices warrant the expense of building the roads necessary to haul it to transportation facilities.

The great falling off in the figures for 1891 as compared with those for 1890 is on account of the practical withdrawal from the business of one of the San Francisco firms handling the ore. The profit is so little that there is nothing to be made commensurate with the trouble involved. Another large broker in this ore has been experimenting with a view to increasing the purity of the marketed article or finding some commercial use for the impurities in the crude ore. He has discovered a process which gives him a purer article, but this purer article can not be shipped at ballast rates as can the crude ore. All the attempts so far made to free the weaker ores from their impurities have failed.

It is then easy to see why, with these hills full of pockets of the ore, but one-third of the quantity demanded by the Baltimore and Philadelphia manufactories has been supplied by California, while the other two-thirds has come from the Mediterranean. Under these discouraging conditions, however, there has been marketed from the Pacific coast the number of tons of chromic iron ore as set forth in the above table. Most of it has been sold by the small producers to two firms in San Francisco, namely, Messrs. N. R. Knight & Co. and Messrs. Kruse & Euler.

The Del Norte mines do not figure in the table of production, and will market no more chromic iron ore until other interests in that locality prompt capitalists to reconstruct roads and railways which were some time ago destroyed by an inundation that swept the valley clean, carrying to the sea, houses, men, roads, and everything. The profit on this ore alone will not justify the construction of the new ways and works.

There is one exception to the statement that there is no mining of chromic iron ore properly speaking in California, to wit, the Pick and Shovel mine, near San Luis Obispo, which has been exploited quite systematically, and in which galleries are now being excavated from exhausted pockets along the line of thin seams of ore in search of contiguous deposits.

The fact that the two consuming firms, the Baltimore Chrome Works, in Baltimore, Maryland, and the Kalion Chemical Company, in Philadelphia, Pennsylvania, are independent of the domestic supply by reason of foreign imports from Turkey is the reason why greater efforts are not made to increase the California product.

Chromic iron ores, the quality ranging from 35 to 55 per cent, Cr_2O_3, are to be found in practically unlimited quantities throughout the range of hills running through the States of California and Oregon west of the Sierra Nevada mountains. It is only the difficulties that surround the transportation of this mineral to a market that prevent those States from being the sole producers of ore for the use of the American factories. In due course these ores will find their way to a market in larger quantities than at present. The fact is that the United States is, under certain conditions, independent of the production of any foreign countries for its supply of this valuable mineral.

Imports.—The following table shows the imports of chromate and bichromate of potash and chromic acid imported and entered for consumption into the United States from 1867 to 1890:

Chromate and bichromate of potash and chromic acid imported and entered for consumption in the United States, 1867 to 1890, inclusive.

[Calendar years since 1886; previous years end June 30.]

Years.	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
1867	875,205	$88,787	....	....	....	....	$88,787
1868	777,855	68,634	....	....	....	....	68,634
1869	877,432	78,288	....	$3	....	....	78,291
1870	1,235,946	127,333	....	8	....	....	127,341
1871	2,170,473	223,529	....	5	....	....	223,534
1872	1,174,274	220,111	514	49	....	....	220,160
1873	1,121,357	178,472	922	276	....	....	178,748
1874	1,387,051	218,517	44	13	....	....	218,530
1875	1,417,812	183,424	45	22	....	....	183,446
1876	1,665,011	175,795	120	45	....	....	175,840
1877	2,471,669	264,392	13	10	....	....	264,402
1878	1,929,670	211,136	32	35	....	....	211,171
1879	2,624,403	221,151	....	....	....	....	221,151
1880	3,505,740	350,279	5	3	....	....	350,282
1881	4,404,237	402,088	124	89	....	....	402,177
1882	2,449,875	261,006	52	42	....	....	261,048
1883	1,990,140	208,681	290	338	....	....	209,019
1884	2,593,115	210,677	....	120	2,677	$73,586	284,383
1885	1,448,539	92,556	....	39	12	239	92,834
1886	1,985,809	139,117	....	101	3,356	43,721	182,949
1887	1,722,465	120,305	....	5,571	1,404	20,812	146,668
1888	1,755,489	143,312	....	281	4,440	46,735	190,328
1889	1,580,385	137,263	....	2,974	5,474	50,782	191,019
1890	1,304,185	113,613	....	634	4,353	57,111	171,358

Foreign sources.—The principal foreign supply comes from Turkish and Grecian deposits, which were described in the last report. The manufacturers in Glasgow obtain their supplies from the same sources, while the Germans obtain a supply from Spain. According to a British consular report, the mines at Dubostica, Austria-Hungary, produce from 2,000 to 3,000 tons of chromic iron ore annually, which goes to Hamburg and Glasgow. The Russian mines produced 9,000 long tons in 1888 and 5,000 long tons in 1889, all from Perm and Orenboorg.

Mr. Henry Bower has determined that the relative quantity of the bichromate of potash and soda produced and sold in the United States is in the proportion of three to one in favor of the potash salt. For many of the uses to which these substances are applied they are not interchangeable, hence bichromate of potash will always remain the more important of the two.

Two factories producing chromates are now in existence in the United States, with a joint capacity sufficient to fill the entire needs of the country. The quantity of bichromates of potash and soda manufactured at these establishments is not known, but it is believed that the consumption of these salts has materially decreased during the past ten years. This is owing to the introduction of dyestuffs requiring a lessened quantity of chromium to produce the same results that were formerly obtained from other dyeing materials. The works mentioned are the Baltimore Chrome Works, at Baltimore, Maryland, and the Kalion Chemical Company, of Philadelphia, Pennsylvania. The relative capacity of the two is not known, but is supposed to be as five is to three in favor of the former.

Prices.—The prices of bichromate of potash since 1845, when it was first manufactured in the United States, are given below:

Prices of bichromate of potash in the United States from 1845 to 1891.

Years.	Cents per pound.	Years.	Cents per pound.
1845	19⅞	1869	16⅞
1846	18¾	1870	14⅛
1847	17⅛	1871	16⅜
1848	16⅜	1872	20 11/16
1849	20¾	1873	20 9/16
1850	22⅝	1874	18⅛
1851	17	1875	18 5/16
1852	15⅝	1876	16⅝
1853	15	1877	13
1854	15 1/16	1878	12 7/16
1855	14 11/16	1879	12 7/16
1856	16⅛	1880	13⅞
1857	18¾	1881	15⅜
1858	20¾	1882	16⅛
1859	19	1883	14 9/16
1860	20¼	1884	11⅛
1861	20¼	1885	10
1862	20⅜	1886	9⅞
1863	23⅜	1887	10
1864	26¼	1888	10¼
1865	25⅛	1889	11⅜
1866	23⅞	1890	10⅛
1867	19⅜	1891	9 13/16
1868	18⅜		

ANTIMONY.

The amount of antimony produced in 1889 was 230,000 pounds, valued at $28,000. In 1890 the product amounted to 257,768 pounds, valued at $40,756. During 1889 the only States producing antimony ore, stibnite, were Arkansas and Nevada, the former having a product of 65 tons and the latter 200 tons. In 1890 Nevada produced 310 tons of ore, 250 tons of which were smelted in San Francisco, producing 190,000 pounds of star regulus. The United States Antimony Company of Philadelphia smelted 111 tons of ore, 81½ tons of which were mined from its own property in Arkansas, and 29½ tons were from the neighborhood of Thompson Falls, Montana. The Arkansas ore yielded in metallic antimony 54,188 pounds, and the Montana ore yielded 13,580 pounds. The total product of ore in Montana was 46 tons, but only 29½ tons of this was smelted. In addition to the 46 tons of "first-class" ore produced in Montana (ore yielding 35 per cent. or more of star regulus being considered first class) there were 200 tons of second-class ore mined, none of which was sold or treated. The amount of ore produced and treated and the amount and value of the antimony obtained in 1889 and 1890 are shown in the following table:

Production of antimony in 1889 and 1890.

Years.	Amount of ore produced.	Amount of ore treated.	Amount of antimony obtained.	Value of metallic antimony.
	Short tons.	*Short tons.*	*Pounds.*	
1889	265	265	230,000	$28,000
1890	435	361	257,768	40,756

Production of antimony from 1882 to 1890.

Years.	Pounds.	Value.	Years.	Pounds.	Value.
1882	120,000	$12,000	1887	150,000	$15,000
1883	120,000	12,000	1888	200,000	20,000
1884	120,000	12,000	1889	230,000	28,000
1885	100,000	10,000	1890	257,768	40,756
1886	70,000	7,000			

Additional facilities for mining and reducing antimony ore were added to the industry in 1890. The United States Antimony Company has sunk about 200 feet of shafts at its mines in Arkansas, and extended several hundred feet of drifts, besides erecting three additional smelting furnaces for the reduction of its ores. Reduction works have also been completed at Lovelock's, Nevada, and the operators state they will hereafter produce metallic antimony at the mines instead of sending the ore to San Francisco for smelting. The demand for antimony was reported as fair during the most of the year, but notwithstanding a good demand the prices fell off from 22½ cents per pound in the early part of the year to 17 cents at the close. As will be seen from the following table the antimony produced in the United States is but a small portion of the amount consumed. The tariff bill passed in 1890 reduced the duty on antimony from 2 cents to ¾ of a cent per pound.

Antimony and antimony ore imported and entered for consumption in the United States, 1867 to 1890.

Years ended—	Crude and regulus.		Ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Pounds.*		*Pounds.*		
1867	....	$63, 919	....	....	$63. 919
1868	1, 033, 336	83, 822	....	....	83, 822
1869	1, 345, 921	129, 918	....	....	129, 918
1870	1, 227, 429	164, 179	....	....	164, 179
1871	1, 015, 039	148, 264	....	$2, 364	150, 628
1872	1, 933, 306	237, 536	....	3, 031	240, 567
1873	1, 166, 321	184, 498	....	2, 941	187, 439
1874	1, 253, 814	148, 409	....	203	148, 612
1875	1, 238, 223	131, 360	6, 460	609	131, 969
1876	946, 809	119, 441	8, 321	700	120, 141
1877	1, 115, 124	135, 317	20, 001	2, 314	137, 631
1878	1, 256, 624	130, 950	20, 351	1, 259	132, 209
1879	1, 380, 212	143, 099	34, 542	2, 341	145, 440
1880	2, 019, 389	265, 773	25, 150	2, 349	268, 122
1881	1, 808, 945	253, 054	841, 730	18, 199	271, 253
1882	2, 525, 838	294, 234	1, 114, 699	18, 019	312, 253
1883	3, 064, 050	286, 892	697, 244	11, 254	298, 146
1884	1, 779, 337	150, 435	231, 360	6, 489	156, 924
December 31—					
1885	2, 579, 840	207, 215	215, 913	7, 497	214, 712
1886	2, 997, 985	202, 563	218, 366	9, 761	212, 324
1887	2, 553, 284	169, 747	362, 761	8, 785	178, 532
1888	2, 814, 044	248, 015	68, 040	2, 178	250, 193
1889	2, 676, 130	304, 711	146, 309	5, 568	310, 279
1890	3, 315, 659	411, 960	611, 140	29, 878	441, 838

PLATINUM.

The production of this substance is almost entirely confined to the western slope of the Ural mountains. Small amounts, however, are produced in South America and a trifling quantity of 600 ounces, worth $2,500 in the crude state, was mined in the United States in 1890 and 500 ounces in 1889, valued at about the same rate.

The two principal platinum producing districts of Russia are situated on the slopes of the Ural mountains, on the Siberian side, and are called the Isa, or Goro-Blagodat district, and the Nisjne Tagilsk, or Demidoff district. They are situated about 100 miles apart, the former being the more northern. Each consists of dried but recent river beds, the Isa district being those forming a part of the Isa river drainage system and the Nisjne Tagilsk district being composed of similar dry tributaries to the Martin (Martian) river. These districts were probably originally gold placers, but there is nothing now to show this, as they are at present worked for platinum only. The platinum producing regions of Russia have been the subject of much speculation by outsiders as to their real nature and conditions on account of the meagerness of definite information obtainable in regard to them, owing to the characteristic secrecy of the Russian managers of these mines. But in the spring and summer of the present year (1891) Mr. George F. Kunz made a trip to these placers and has thrown much light on this hitherto dark subject. The Isa district is under the control of the Government, but the Nisjne Tagilsk district is worked as a business enterprise and is a part of the Demidoff estate, which was granted to the prince in order that these placers might be worked. For a further account of how these mines are worked, the cost of labor, etc., the reader is referred to the report of the Eleventh Census on the "Mineral Industries in the United States," where the results of Mr. Kunz's trip are given in detail. This report contains several illustrations of the deposits and the methods of washing the sand, etc., which will be found interesting and of much value.

The following table gives the production of platinum in Russia from 1880 to 1889, and is compiled from the best sources obtainable:

Product of platinum in Russia from 1880 to 1889.

Years.	Quantity.	Years.	Quantity.
	Kilograms.		*Kilograms.*
1880	2,947	1885	2,591
1881	2,986	1886	4,317
1882	4,081	1887	4,242
1883	3,537	1888	2,636
1884	2,237	1889	2,708

Price.—The price of platinum was phenomenally high during 1889 and 1890. It averaged above $16 per ounce. The cause of this rise in price is generally attributed to a purchase of a large quantity of scrap platinum by Messrs. Johnson, Matheys & Co. and Des Moutis, Le Brun & Co. They purchased about 500,000 ounces. The consequent rise in price led to old platinum being brought from many unexpected places. The quantity was too large for the price to remain so high, and it declined again by the close of 1891 to $9.50 per ounce. It is probable that the fluctuations in the near future will only be such as result from Russian finances. The price late in 1891 rose slightly at the mines on account of the change in the value of the Russian ruble. The high prices prevailing in 1889 and 1890 stimulated Russian production.

IMPORTS.

Platinum imported and entered for consumption in the United States, 1867 to 1890.

Calendar years ending December 31 since 1886; previous years end June 30.	Manufactured.	Unmanufactured.		Vases or retorts, etc.
		Quantity.	Value.	
		Pounds.		
1867	$456	....	....	....
1868	290	....	$95,208	$20,274
1869	184	....	80,014	22,004
1870	648	....	99,984	16,294
1871	48	....	108,244	22,470
1872	810	....	91,472	21,816
1873	43	....	90,771	9
1874	143	....	123,293	59,698
1875	173	....	141,188	18,082
1876	6	....	141,207	7,421
1877	11	....	81,925	18,611
1878	241	....	120,121	50,183
1879	73	....	166,178	34,209
1880	964	....	217,144	41,827
1881	290	....	273,343	21,292
1882	1,731	8,125.60	285,731	48,452
1883	4	3,104.15	298,799	92,967
1884	....	2,846.00	289,898	83,112
1885	3	2,612.34	285,239	17,473
1886	....	3,422.00	373,941	71,864
1887	....	4,732.00	509,414	68,051
1888	....	5,226.00	558,920	58,355
1889	338	5,394.00	555,742	110,757
1890	....	5,763.00	996,886	77,957

Value of platinum exports.

Calendar years ending December 31 since 1886: previous years end June 30.	Unmanufactured.	Manufactured.	Old platinum.
1880	....	....	$600
1881	....	....	4,222
1882	....	$19,244	....
1883	$6,250	21,600	....
1884	....	18,587	1,130
1885	....	....	7,000
1886	....	4,048	2,000
1887	....	2,200	17,500
1888	....	....	....
1889	....	....	36,835
1890	....	....	14,500

COAL.

By E. W. Parker.

INTRODUCTION.

The present chapter on the coal production of the United States covers the calendar years 1889 and 1890. The statistics for 1889 were collected by the Census Office and those for 1890 have been compiled mainly from direct returns from operators. The section on anthracite coal has been prepared by Mr. John H. Jones, statistician of the Pennsylvania anthracite coal companies. The material for the Rocky Mountain section was collected by Mr. Frederick F. Chisolm, special agent at Denver, Colorado. The report on the product from Illinois is from that of Col. J. S. Lord, secretary of the bureau of labor statistics of the State of Illinois, while acknowledgments are due to Mr. Albert S. Bolles, chief of the bureau of industrial statistics of Pennsylvania, for valuable information obtained from his report on bituminous coal in that State. The data for the reports of all the bituminous coal-producing States have been collected by correspondence with individual operators. This method of conducting the investigation was rendered practicable by the work of the Census Office, through which a very complete directory of coal producers throughout the United States was obtained. Replies to the inquiries sent out from this office have been received from nearly all those addressed, leaving only a very small percentage of output on which it was necessary to make an estimate. It is believed that the present investigation has resulted in a more accurate statement of the coal product than has hitherto been possible, as no opportunity has been afforded in the compilation of previous volumes of Mineral Resources to obtain direct reports from all the mines. In the report for 1890 no attempt has been made to obtain the statistics from country banks where the output is used entirely for local consumption, an estimate of this small factor being all that was possible. The investigation has been limited to mines which are known as commercial properties. The output from small banks in 1889 was 2,889,286 short tons, or a little more than 2 per cent. of the total product.

THE COAL FIELDS OF THE UNITED STATES.

For convenience of description, the coal areas of the United States have been grouped into the Anthracite division and the Bituminous division.

The Anthracite division, in a commercial sense, may be said to include the anthracite districts of Pennsylvania alone, although small amounts of anthracite are mined in Colorado, Arkansas, and New Mexico. In the New England basin the original coal beds have been metamorphosed into graphite and graphitic coal, which have special uses, although not classified by the coal trade as anthracite.

The Bituminous division includes the following coal fields: (1) The Triassic field, embracing the coal beds of the Triassic or New Red sandstone formation in the Richmond basin in Virginia, and in the coal basins along the Deep and Dan rivers in North Carolina; (2) the Appalachian field, which extends from the State of New York on the north to the State of Alabama on the south, having a length northeast and southwest of over 900 miles and a width ranging from 30 to 180 miles; (3) the Northern field, which is confined exclusively to the central part of Michigan; (4) the Central field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the Western field, including the coal areas west of the Mississippi river, south of the forty-third parallel of north latitude and east of the Rocky mountains; (6) the Rocky mountain field, containing the coal areas in the States and Territories lying along the Rocky mountains; (7) the Pacific coast field, embracing the coal districts of Washington, Oregon, and California. (See Mineral Resources of the United States, 1886, for detailed descriptions.)

The following table contains the approximate areas of these coal fields, with the total product of each during 1887, 1888, 1889, and 1890:

Classification of the coal fields of the United States.

	Area.	Product in 1887.	Product in 1888.	Product in 1889.	Product in 1890.
Anthracite.					
	Sq. miles.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
New England (Rhode Island and Massachusetts)	500	6,000	4,000	2,000	....
Pennsylvania	470	39,506,255	43,922,897	45,544,970	46,468,641
Colorado and New Mexico	15	36,000	44,791	53,517	(*b*)
	985	39,548,255	43,971,688	45,600,487	46,408,641
Bituminous (a).					
Triassic:					
Virginia	180	30,000	33,000	49,411	19,346
North Carolina	2,700	....	....	222	10,262
Appalachian:					
Pennsylvania	9,000	30,866,602	30,796,727	36,174,089	42,302,173
Ohio	10,000	10,301,708	10,910,946	9,976,787	11,494,506
Maryland	550	3,278,023	3,479,470	2,939,715	3,357,813
Virginia	2,000	795,263	1,040,000	816,375	764,665
West Virginia	16,000	4,836,820	5,498,800	6,231,880	7,394,494
Kentucky	10,000	950,903	1,193,000	1,108,770	1,206,120
Tennessee	5,100	1,900,000	1,967,297	1,925,689	2,169,585
Georgia	200	313,715	180,000	225,934	228,387
Alabama	8,660	1,950,000	2,900,000	3,572,983	4,090,409
	64,395	55,193,034	60,966,240	62,972,222	73,008,102
Northern:					
Michigan	6,700	71,461	81,407	67,431	74,977
Central:					
Indiana	6,450	3,217,711	3,140,979	2,845,057	3,305,737
Kentucky	4,000	982,282	1,377,000	1,290,985	1,495,376
Illinois	36,800	10,278,890	14,655,188	12,104,272	15,292,420
	47,250	14,478,883	19,173,167	16,240,314	20,093,533

a Including lignite, brown coal, and scattering lots of anthracite.
b Included in bituminous product.

Classification of the coal fields of the United States—Continued.

	Area.	Product in 1887.	Product in 1888.	Product in 1889.	Product in 1890.
Bituminous—Continued.					
Western:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Iowa	18,000	4,473,828	4,952,440	4,045,358	4,021,739
Missouri	26,700	3,209,916	3,909,967	2,557,823	2,735,221
Nebraska	3,200	1,500	1,500	2,222,443	2,259,922
Kansas	17,000	1,596,879	1,850,000		
Arkansas	9,100	150,000	276,871	279,584	399,888
Indian Territory	20,000	685,911	761,986	752,832	869,229
Texas	4,500	75,000	90,000	128,216	184,440
	98,700	10,193,034	11,842,764	10,036,256	10,470,439
Rocky Mountains, etc.:					
Dakota	....	21,470	34,000	28,907	30,000
Montana	....	10,202	41,467	363,301	517,477
Idaho	....	500	400	....	....
Wyoming	....	1,170,318	1,481,540	1,388,947	1,870,366
Utah	....	180,021	258,961	236,651	318,159
Colorado	....	1,755,735	2,140,686	2,544,144	3,094,003
New Mexico	....	508,034	626,665	486,463	375,777
	....	3,646,280	4,583,719	5,048,413	6,205,782
Pacific coast:					
Washington	....	772,612	1,215,750	1,030,578	1,263,689
Oregon	....	81,696	75,000	64,859	61,514
California	....	50,000	95,000	119,820	110,711
	....	854,308	1,385,750	1,214,757	1,435,914
Total product sold	....	124,015,255	142,037,735	....	....
Colliery consumption	....	5,960,302	6,621,667	....	....
Total product, including colliery consumption	....	129,975,557	148,659,402	141,229,513	157,788,656

PRODUCT.

The total product of all kinds of coal in 1889, including colliery consumption, was, according to the census report, 141,229,513 short tons, (decrease from 1888 of 7,429,889 short tons), valued at $160,226,323 (decrease $51,292,404). In 1890 the product increased to 157,788,656 short tons, valued at $176,804,573. The increase in tonnage in 1890 over that of 1889 was 16,559,143 short tons, and in value of $16,578,250. The product of Pennsylvania anthracite in 1889 was 40,665,152 long tons, or 45,544,970 short tons, valued at $65,721,578 (a decrease from 1888 of 959,459 long tons, or 1,074,594 short tons). In 1890 the product was 41,489,858 long tons, or 46,468,641 short tons (increase over 1889, 824,706 long tons, or 923,671 short tons), valued at $66,383,772 (increase, $662,184). The product of all other coals, including bituminous, semibituminous, brown, and lignite, and Arkansas and Colorado anthracite, in 1889, was 95,684,543 short tons, valued at $94,504,745, and in 1890, 111,320,015 short tons, valued at $110,420,801.

The colliery consumption varies considerably, according to the nature of the mines. The total amount so used in 1889 was reported to be 5,382,265 short tons, and in 1890, 4,457,456 short tons. The largest average consumption is reported from the anthracite mines of Pennsylvania, and the smallest average in the bituminous region of the same State.

The total number of persons employed in and about the coal mines in 1889 was 299,559, and in 1890, 318,204. These figures include superintendents, mechanics, and clerical force at the mines, as well as miners, laborers, and others engaged in the actual working of the mines.

The total product, including colliery consumption, of each State and Territory during 1889 and 1890, with corresponding values, are shown in the following tables:

Product of coal in the United States in 1889, by States and Territories.

States and Territories.	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.	Total product of coal of all grades for year 1889.	Total amount received for coal sold in 1889.
Bituminous.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Alabama	2,327,209	38,835	21,110	79,515	1,106,814	3,572,983	$3,961,491
Arkansas	268,518	5,020	1,800	4,246	....	279,584	395,836
California and Oregon	173,611	3,854	608	6,106	....	184,179	434,382
Colorado	2,059,848	70,595	18,453	87,187	308,061	2,544,144	3,843,992
Georgia and North Carolina	46,321	31	158	15,001	164,645	226,156	339,382
Illinois	9,884,883	1,699,478	111,224	395,787	12,900	12,104,272	11,755,203
Indiana	2,527,112	217,041	20,894	67,210	12,800	2,845,057	2,887,852
Indian Territory	699,122	1,173	5,922	38,997	12,618	752,832	1,323,807
Iowa	3,580,373	420,596	44,139	100,213	37	4,095,358	5,426,509
Kansas and Nebraska	1,891,090	267,047	34,560	29,246	500	2,222,443	3,301,788
Kentucky	2,111,010	225,234	21,072	23,981	18,458	2,399,755	2,374,339
Maryland	2,885,336	37,667	6,550	10,162	....	2,939,715	2,517,474
Michigan	53,104	8,289	821	5,217	....	67,431	115,011
Missouri	2,246,845	259,587	16,412	34,979	....	2,557,823	3,479,057
Montana	314,872	10,755	2,162	5,436	30,576	363,801	880,773
New Mexico	466,127	5,371	2,582	6,383	6,000	486,463	870,468
North Dakota	18,610	9,792	505	....	....	28,907	41,431
Ohio	8,566,223	1,196,872	50,271	93,952	69,469	9,976,787	9,355,400
Pennsylvania	24,059,918	1,432,361	158,290	332,937	10,190,588	36,174,089	27,953,315
Tennessee	1,334,424	18,212	15,889	23,034	539,130	1,925,689	2,338,309
Texas	120,602	6,348	204	1,062	....	128,216	340,620
Utah	216,960	15,050	2,012	412	2,217	236,651	877,456
Virginia	732,881	7,546	5,633	7,516	112,210	865,786	804,475
Washington	956,046	11,036	4,538	19,958	39,000	1,030,578	2,393,238
West Virginia	4,764,900	448,527	44,760	37,368	936,325	6,231,880	5,086,584
Wyoming	1,354,443	7,330	8,103	19,071	....	1,388,947	1,748,617
Total	78,609,883	6,418,647	598,672	1,439,976	13,561,848	95,629,026	94,346,809
Anthracite.							
Pennsylvania	40,114,901	1,163,539	325,591	3,940,939	....	45,544,970	65,721,578
Colorado and New Mexico	49,917	350	1,900	1,350	....	53,517	151,936
Rhode Island	2,000	....	....	....	....	2,000	6,000
Total	40,166,818	1,163,889	327,491	3,942,289	....	45,600,487	65,879,514
Grand total	118,776,701	7,582,536	926,163	5,382,265	13,561,848	141,229,513	160,226,323

Coal product of the United States in 1890, by States.

States.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Pennsylvania, anthracite	41, 011, 087	2, 000, 891	3, 456, 663	....	46, 468, 641	$66, 383, 772	200	126, 000
Bituminous:								
Alabama	2, 487, 988	84, 578	88, 952	1, 428, 896	4, 090, 409	4, 202, 469	217	10, 642
Arkansas	374, 969	9, 240	15, 679	....	399, 888	514, 595	214	938
California	103, 436	2, 121	5, 154	....	110, 711	283, 019	301	364
Colorado	2, 636, 939	65, 432	48, 451	343, 181	3, 094, 003	4, 344, 196	220	5, 827
Georgia	57, 949	....	....	170, 388	228, 337	238, 315	313	425
Illinois	12, 539, 784	2, 130, 539	606, 497	15, 690	15, 292, 420	14, 171, 230	204	28, 574
Indiana	3, 036, 737	225, 167	34, 703	9, 130	3, 305, 737	3, 259, 233	220	5, 489
Indian Territory	828, 102	6, 211	11, 292	23, 624	869, 229	1, 579, 188	228	2, 571
Iowa	3, 560, 738	397, 503	63, 498	....	4, 021, 739	4, 995, 739	218	8, 130
Kansas	2, 028, 100	224, 839	6, 983	....	2, 259, 922	2, 947, 517	210	4. 523
Kentucky	2, 357, 989	291, 666	29, 568	22, 273	2, 701, 496	2, 472, 119	219	5, 259
Maryland	3, 296, 393	52, 621	8, 799	....	3, 357, 813	2, 899, 572	244	3, 842
Michigan	57, 100	12, 885	4, 992	....	74, 977	149, 195	229	180
Missouri	2, 449, 305	240, 237	45, 679	....	2, 735, 221	3, 382, 858	229	5, 971
Montana	466, 016	23, 427	4, 034	24, 000	517, 477	1, 252, 492	218	1, 251
Nebraska	....	1, 500	....	....	1, 500	4, 500	....	....
New Mexico	358, 332	11, 360	6, 085	....	375, 777	504, 390	192	827
North Carolina	9, 262	100	900	....	10, 262	17, 864	200	80
North Dakota	....	30, 000	....	....	30, 000	42, 000	....	....
Ohio	10, 161, 887	1, 164, 876	143, 984	23, 759	11, 494, 506	10, 783, 171	201	20, 576
Oregon	58, 821	1, 936	757	....	61, 514	177, 875	305	208
Pennsylvania	29, 288, 923	1, 473, 317	395, 837	11, 144, 096	42, 302, 173	35, 376, 916	232	61, 333
Tennessee	1, 482, 357	41, 932	23, 583	621, 718	2, 169, 585	2, 395, 746	263	5, 082
Texas	180, 800	1, 840	1, 800	....	184, 440	465, 900	241	674
Utah	279, 336	13, 749	1, 015	24, 059	318, 159	552, 390	289	429
Virginia	608, 641	17, 002	4, 908	153, 460	784, 011	589, 925	296	1, 295
Washington	1, 212, 621	17, 249	17, 019	16, 800	1, 263, 689	3, 426, 590	270	2, 206
West Virginia	5, 614, 752	438, 527	30, 594	1, 310, 781	7, 394, 654	6, 208, 128	227	12, 236
Wyoming	1, 835, 299	28, 540	6, 527	....	1, 870, 366	3, 183, 669	246	3, 272
Total	128, 383, 658	9, 009, 285	5, 063, 953	15, 331, 760	157, 788, 656	176, 804, 573	216	318, 204

IMPORTS AND EXPORTS.

The following tables have been compiled from official returns to the Bureau of Statistics of the Treasury Department and show the imports and exports of coal from 1867 to 1890 inclusive. The values given in both cases are considerably higher than the average "spot" rates by which the values of the domestic production have been computed.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846, 30 per cent. ad valorem; 1847 to 1861, 24 per cent. ad valorem; 1862 to 1864, $1 per ton; 1865, $1.10 per ton; 1866 to 1872, $1.25 per ton; since August, 1872, 75 cents per ton. During the period from June, 1854, to March, 1866, the reciprocity treaty was in force, and coal from the British possessions in North America was admitted into the United States duty free.

The exports consist both of anthracite and bituminous coal, the amount of anthracite being the greater. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to

San Francisco, from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

Coal imported and entered for consumption in the United States, 1867 to 1890.

Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867	....	....	509,802	$1,412,597
1868	....	....	394,021	1,250,513
1869	....	....	437,228	1,222,119
1870	....	....	415,729	1,103,965
1871	973	$4,177	430,508	1,121,914
1872	390	1,322	485,063	1,279,686
1873	2,221	10,764	460,028	1,548,208
1874	471	3,224	492,063	1,937,274
1875	138	963	436,714	1,791,601
1876	1,428	8,560	400,632	1,592,846
1877	630	2,220	495,816	1,782,941
1878	158	518	572,846	1,929,660
1879	488	721	486,501	1,716,209
1880	8	40	471,818	1,588,312
1881	1,207	2,628	652,963	1,988,199
1882	36	148	795,722	2,141,373
1883	507	1,172	645,924	2,013,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,432
1886	2,039	4,920	811,657	2,501,153
1887	14,181	42,983	819,242	2,609,811
1888	24,093	68,710	1,085,647	3,728,060
1889	20,652	117,434	1,001,374	3,425,347
1890	15,145	46,695	819,971	2,822,216

Coal of domestic production exported from the United States, 1867 to 1890.

Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867	192,912	$1,333,457	92,189	$512,742
1868	192,291	1,082,745	86,367	433,475
1869	283,783	1,553,115	....	....
1870	121,098	803,135	106,820	503,223
1871	134,571	805,169	133,380	564,067
1872	259,567	1,375,842	141,311	586,264
1873	342,180	1,827,822	242,458	1,086,253
1874	401,912	2,236,084	361,490	1,587,666
1875	316,157	1,791,626	203,189	828,943
1876	337,934	1,869,434	230,144	850,711
1877	418,791	1,891,351	321,665	1,024,711
1878	319,477	1,006,843	340,661	1,352,624
1879	386,916	1,427,886	276,000	891,512
1880	392,626	1,362,901	222,634	695,179
1881	462,208	2,091,928	191,038	739,532
1882	553,742	2,589,887	314,320	1,102,898
1883	557,813	2,648,033	463,051	1,593,214
1884	649,040	3,053,550	646.265	1,977,959
1885	588,461	2,586,421	683,481	1,989,541
1886	667,076	2,718,143	544,768	1,440,631
1887	825,486	3,469,166	706,364	2,001,966
1888	969,542	4,325,126	860,462	2,529,472
1889	857,633	3,636,347	935,151	2,783,592
1890	794,335	3,272,697	1,280,930	4,004,995

COAL TRADE REVIEW.

Including the coal sold to local trade (*i. e.*, the portion of the product sold without shipment by rail or water), the amount made into coke, and that used at the mines for steam and heat, the total production for 1889 was 7,429,889 short tons less than that of 1888. The decrease in value was $51,292,404. The mild winter of 1889–'90 is a satisfactory reason for this decided decrease, though it is quite evident that the product for 1888 was over-estimated. The slackened demand during the season caused a drop in prices still more pronounced than the decrease in tonnage. Heavy stocks, accumulated during the impetus given to trade by the activity in 1888, had to be moved, and prices fell accordingly. The depression of 1889 was followed by a heavier production in 1890. The product increased 16,559,143 short tons, and the value, $16,578,250.

The spot value of anthracite coal, inclusive of colliery consumption, in 1888 was estimated at $1.95 per ton, which was 6 cents lower than the average price during 1887. The average price in 1889 was $1.77, or 18 cents less than that of 1888. The average price in 1890 was $1.78 per ton.

The condition of the market during 1890 may be seen from the following review, made up partly from market reports to the various trade journals, but more particularly from Mr. Frederic E. Saward's annual report, "The Coal Trade."

New York.—The mild winter of 1889–'90 had a particularly depressing effect upon the anthracite trade, and prices were very much at the option of buyers, with the exception of manufacturing sizes, which were in demand. The prices quoted in the early part of 1890 for coal, free on board at New York, were as follows: Stove, $3.90 to $4; egg, $3.70 to $3.80; chestnut, $3.65 to $3.75. Notwithstanding a general reduction in output during February (some collieries shutting down entirely) prices fell off early in the month to $3.50, free on board, for stove and egg, and $3.35 for chestnut. Pea and buckwheat were scarce, however, and commanded anywhere from $2.85 to $3.10 and $2.25 to $2.40. A better tone was given to the market in April and May. The prices on Reading white ash were as follows: Broken egg and stove advancing to $3.75 and chestnut to $3.50, free on board, at New York, with pea at $2.65 and buckwheat at $1.80 to $2, though other coals were quoted at $3.50 for broken stove and egg and $3.25 for chestnut. The market continued to advance during the summer, operators having materially reduced stocks at the shipping points by reducing production. In September the prices at New York were quoted as follows: Stove, $4.15; egg, $3.90; chestnut, $3.75, and broken, $3.75. In October the prices advanced still further, being for stove, $4.30; egg, $4.05; chestnut, $3.95; broken, $3.74, pea; $2.60 to $2.75. In November an attempt was made to get another advance of 15 cents per ton on all sizes in anticipation of colder weather and an increasing demand, but the element of competition made itself felt, and this, in connection with the recurrence of mild winter weather, caused another decline in prices, and the year closed with schedules demoralized and actual selling prices ranging about the same as September.

Owing to the large consumption of bituminous coal for manufacturing purposes the industry is not so liable to be affected by the fluctuations of the thermometer as is the anthracite trade. The year opened with a good demand and operators mining freely, but with trade somewhat hampered by inadequate transportation facilities. A plan for combination of the bituminous coal producers was formulated in 1889, and strenuous efforts were made during the early months of 1890 to perfect a scheme for controlling the market, but the matter fell through, the failure being due in some degree, probably, to the refusal of Norfolk, and Western, and Chesapeake and Ohio operators to enter the combination. The Pocohontas and Hawk's Nest districts were anxious to increase their output and were doubtless afraid that combination would mean restriction.

On March 1 quotations were made as follows: $2.60, free on board, at Baltimore, Newport News, and Philadelphia, and $3.25 in New York harbor. During the late spring and early summer the market was unstable, showing a sympathy with the anthracite trade. Prices were variable without much attention paid to schedules and quotations. A strike was threatened among the miners in the Hocking Valley and Pittsburg districts, but was averted by an agreement to pay an advance of 5 cents in the Hocking Valley district and of 6 cents in the Pittsburg district, the new scale being 70 cents and 79 cents, respectively. This was followed by threatened strikes in Indiana, Illinois, and West Virginia, but the companies succeeded in compromising with the men and averted the strike. Prices became firmer toward the first of June, and these schedule quotations were abided by: $2.40 to $2.50 at Baltimore and Newport News, $2.50 to $2.60 at Philadelphia, and $3.25 at New York. A demand made by the Pennsylvania Railroad Company, in June, of $1 demurrage on each car per day for cars not unloaded at delivery points caused a rapid increase of stocks, but prices remained without material change until about the last of August, when they were quoted as "nominal," and cutting from schedule figures became general. This state of affairs continued until October, when a scarcity of cars caused a diminution of stocks and a stiffening of prices to the schedule rates, which were $2.40, free on board, at Baltimore, $2.50 at Philadelphia, and $3.15 at New York. During November the market improved and an advance of 10 cents was noted at Baltimore and Philadelphia, New York remaining at $3.15. In December snow blockades and increased demands caused a scarcity at the distributing points, and it was with difficulty that the demand was met. Dealers were obliged to buy from other dealers in order to supply their customers, and prices were high, the closing quotations for the year being $2.70 at Baltimore, $2.80 at Philadelphia, and $3.35 at New York.

Boston, Massachusetts.—The receipts of coal at the port of Boston for a series of years has been as follows:

Receipts of coal at Boston for eight years.

Years.	Anthracite.	Bituminous.	From Cape Breton.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1883				2,273,068
1884				2,225,740
1885				2,221,220
1886				2,500,000
1887				2,400,000
1888	2,057,279	1,004,195		3,061,474
1889	1,647,348	914,966	5,538	2,567,852
1890	1,740,564	964,857	14,072	2,719,493

The amounts here given do not represent the consumption of coal in the city of Boston, as about three-fifths of the coal received at the port is shipped to interior points, but it is not possible to determine the exact quantity.

The hard coal business of Boston and vicinity in 1889 was an unsatisfactory one. The commencement of the year found both wholesale and retail dealers well supplied with coal. The previous year was a very quiet one on account of the warm weather, and as retail dealers had laid in a good supply of coal in anticipation of an average demand, which did not materialize, large stocks were carried over. Notwithstanding the slack demand, however, prices were held up by the producing companies until the summer months, when considerable cutting was done. Trade in bituminous coal, on the other hand, was quite the reverse of the anthracite. Business was brisk, and owing to delays at shipping points and lack of transportation facilities some difficulty was experienced at times in supplying the local demand. The circular price for the year was $2.60, free on board, and as at times there were threatenings of a famine in bituminous circles the rate was pretty generally maintained.

The beginning of 1890 found the anthracite market well stocked and the first months of the year were about as unsatisfactory as the previous year. In fact, the only really satisfactory trading that was done during the year was in the few weeks of cold weather which prevailed in November and December. Freights during the year were very low, and vessels for transportation rather a drug. This condition of affairs drove many vessels out of the traffic, and naturally a rise in freights resulted toward the close of the year. Freight tariffs in the earlier months of the year had been from New York 50 cents, and from Philadelphia 75 cents. Following the withdrawal of vessels from the trade the rates rose to 75 and 85 cents from New York and to $1 and over from Philadelphia and Baltimore.

Philadelphia, Pennsylvania.—Lack of competition among the coal transportation companies has made Philadelphia a sufferer. Freights from the Schuylkill region are but 5 cents per ton less than to New York. From the Lehigh they are the same, and from the Wyoming they are 10 cents higher. The following rates ruled during 1889 and 1890 for coal from the mines to Philadelphia:

Freight rates from coal mines to Philadelphia.

	Anthracite.	Bituminous.
	Per ton.	*Per ton.*
For local use	1.70	2.00
For shipment out of Delaware bay	1.40	1.50

The wholesale prices for anthracite coal, free on board, at Port Richmond, averaged as follows during the past two years:

Average prices of anthracite coal at Port Richmond in 1889 and 1890.

Kind of coal.	Broken.	Egg.	Stove.	Chestnut.	Pea.
1889.	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*
Hard white ash	3.70	3.85	4.05	3.80	2.10
Free-burning white ash	3.50	3.75	3.95	3.75	2.10
1890.					
Hard white ash	3.65	3.90	4.05	3.70	2.25
Free-burning white ash	3.50	3.75	4.05	3.70	2.25

Director Wagner, on December 27, 1888, awarded contracts for supplying the city with gas coal during the year 1889. The following were the successful bidders. The prices paid for 1888 were $3.79, $3.83 and $3.84.

Contracts for supplying gas coal to Philadelphia in 1889.

Companies.	Tons.	Price per ton.
Manor Gas Coal Co	5,000	$3.81
Penn Gas Coal Co	57,720	3.82
Westmoreland Coal Co	57,720	3.82
Newburg Orrel Coal and Coke Co	15,000	3.76
James Boyce	15,000	3.76
Despard Coal Co	10,000	3.76
J. & W. Wood	10,000	3.76
Chesapeake and Ohio	25,000	3.80

For 1890 the coal supplied to the gas works was at $3.80 per ton, and the bids for the 1891 supply were as follows:

Bids for supplying gas coal to Philadelphia for 1890.

Companies.	Price per ton.
Montana Coal and Coke Co	$3.91
Gaston Coal Co	3.91
Despard Coal Co	3.91
Chesapeake and Ohio	3.94
Manor Gas Coal Co	3.98
Westmoreland Coal Co	3.99

Freight rates from Philadelphia at the close of 1890.

To—	Rate per ton.	To—	Rate per ton.
Boston and discharge	$1.15	Providence and discharge	$0.85
Portsmouth and discharge	1.00	Portland and discharge	.75
Newburyport and discharge	1.00	Savannah and discharge	1.00
New Bedford and discharge	.75	New York, alongside	.90
Lynn and discharge	1.00	Washington, alongside	.85
Fall River and discharge	.90	Norfolk	.70

Baltimore, Maryland.—The coal received at Locust Point for the Baltimore market includes Cumberland, Georges Creek, Myersdale, and the gas coal from the West Virginia mines on the line of the Baltimore and Ohio railroad, and that from the Youghiogheny mines in Pennsylvania on the line of the same road, for local use and for northern shipment, and it is estimated that 200,000 tons were received during 1890. Of anthracite coal received there were something like 250,000 tons by the Susquehanna canal, and other water routes, besides 300,000 tons by the Northern Central railroad.

Rates for anthracite coal in cars, at Baltimore, or via Canton pier at the close of 1890.

	Hard white ash.	Shamokin.	Lykens Valley	Bernice.
Broken	$4.20			$4.30
Egg	4.30	$4.30	$4.45	4.30
Stove	4.45	4.45	4.70	4.45
Chestnut	4.30	4.30	4.35	4.30
Pea	3.00	3.00	3.25	
Buckwheat				

Bituminous coal was quoted at $2.60 per long ton free on board at Locust Point or Canton piers. Hampton Roads quotations were the same.

The Baltimore and Ohio, Northern Central, and Baltimore and Potomac railroads carried the following to Baltimore:

Coal receipts at Baltimore.

Years.	Via Baltimore and Ohio Railroad.	Via Northern Central Railroad.	Via Baltimore and Potomac Railroad.
	Tons.	*Tons.*	*Tons.*
1883	1,618,416	693,494	
1884	2,510,389	767,381	
1885	2,238,097	850,303	
1886	2,313,783	818,863	
1887	2,167,007	765,082	15,338
1888	2,300,000	680,902	16,500
1889	2,000,000	666,972	7,139
1890	2,200,000	700,000	10,000

Foreign shipments of coal from Baltimore.

Years.	Tons.	Years.	Tons.
1883	63,526	1887	54,455
1884	50,289	1888	33,386
1885	71,527	1889	27,520
1886	64,477	1890	30,000

Freight rates for coal from Baltimore at the close of 1890.

To—	Rate per ton.	To—	Rate per ton.
Portland	$1.00	Bridgeport	$1.00
Boston	1.15	Providence	1.00
Portsmouth	1.25	Hoboken	.95
New Haven	1.00	Jersey City	.85
New York	1.00	New Bedford	1.00

Pittsburg, Pennsylvania.—The following prices were quoted at the close of 1890:

Pittsburg coal prices at the close of 1890.

	Per bushel.
	Cents.
River, on board	4½ to 5
Railroad	5 5½

The fluctuations in the price of Pittsburg coal at Cincinnati, Louisville, and New Orleans during 1889 and 1890 are indicated below:

Prices of Pittsburg coal at Cincinnati, Louisville, and New Orleans. (*a*)

Months.	Cincinnati.	Louisville.	New Orleans.
1889.	*Cts. per bushel.*	*Cts. per bushel.*	*Cts. per barrel.*
January	5 to 6¼	6½ to 7	27 to 29
March	5 6	6½ 7	27 29
April	5 6	6 7	25 27
September	5 7½	6 7½	25 27
October	6½ 8	6½ 8	25 27
November	5½ 8	5½ 8	21 27
December	5½ 6½	5½ 7	22 24
1890.			
January	5½ 6½	6 7	23 25
April	5 6	5 6	22 24
July	5½ 6½	5½ 6½	22 24
October	5½ 6½	6 6½	24 26
December	5½ 6½	6½ 7	26 28

a Rates at Cincinnati and Louisville are for bushels of 76 pounds; at New Orleans for barrels of 208 pounds.

Coal shipments by Ohio river for eight years.

Years.	Bushels.	Years.	Bushels.
1883	87,995,000	1887	56,743,000
1884	55,432,000	1888	109,572,000
1885	74,964,000	1889	79,578,100
1886	91,664,000	1890	116,302,600

The railroad coal operators report unsatisfactory and unprofitable business for both 1889 and 1890. The product of Allegheny county in 1889 was 858,074 short tons less than in 1888. The value of the product in 1889, according to the Census Office, was $4,000,104, against which the total expenditures are given at $3,739,439, leaving a profit of $261,665. The annual report of the Monongahela Navigation Company for 1890 shows the total receipts from coal tonnage to be $204,000. An expense approximately the same for 1889, deducted from the gross profits above quoted, will enable one to judge how much there was in the business for operators.

Buffalo, New York.—The prices for anthracite coal, free on board, at the close of 1890, were as follows:

Prices for anthracite coal at Buffalo, New York.

Sizes.	Per long ton.	Sizes.	Per long ton.
Stove	4.24	Grate	4.01
Chestnut	4.24	Egg	4.01

The Buffalo Coal Exchange rules say that when coal is sold in the yard the price shall be 40 cents per ton less than delivered figures. Rates to steam yachts and canal boats shall be the same on deck per ton as the regularly established retail quotations. Further, all coal shall be sold at regularly established retail prices, and these prices are for coal delivered only during the month in which the order is taken.

Prices for bituminous coal at Buffalo, New York, on track (nominal).

	Reynoldsville region.	Allegheny Valley Railroad and Mercer County region.	Pittsburg region.	Low grade division of Allegheny Valley Railroad.
	Short ton.	*Short ton.*	*Short ton.*	*Short ton.*
Screened lump	$2.45	$2.25	$2.60	$2.25
Lump and nut mixed	2.35	2.15	2.50	2.15
Run of mines	2.20	2.00	2.55	2.00
Screened nut	2.20	2.00		2.00
Nut and slack mixed	2.00	1.80		1.80
Slack	1.70	1.50		1.50
Ohio cannel				
Connellsville coke			4.30	
Reynoldsville coke			3.75	

The close of 1890 found the coal trade of Buffalo in an unsettled and unsatisfactory condition. A general stagnation existed in the local anthracite trade, while bituminous coal was scarce and hard to get from the mines, owing to the operators inability to secure cars to haul it, and the further trouble of snow blockades on the railroads.

The following table exhibits the shipments of anthracite coal from Buffalo for the past eight years:

Lake shipments of anthracite coal from Buffalo.

Years.	Tons.	Years.	Tons.
1883	1,467,778	1887	1,894,060
1884	1,431,081	1888	2,514,906
1885	1,428,086	1889	2,151,670
1886	1,581,210	1890	2,157,810

The principal points to which coal was shipped from Buffalo by lake during the past five years are shown in the following table, together with the tonnage for each year:

Clearances of coal at Buffalo for five years.

Destination.	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago	642, 135	784, 462	1, 023, 649	988, 750	952, 280
Milwaukee	376, 615	376, 876	549, 831	497, 895	451, 550
Duluth	157, 420	165, 798	282, 106	160, 430	199, 230
Superior	65, 090	96, 746	120, 000	112, 450	127, 300
Toledo	55, 290	84, 563	83, 850	52, 725	96, 230
Gladstone	....	....	39, 575	36, 520	30, 215
Racine	25, 263	16, 565	29, 695	33, 410	29, 130
Detroit	31, 090	40, 203	35, 330	31, 890	40, 065
Green Bay	23, 870	29, 446	26, 345	25, 050	22, 380
Other places	156, 439	140, 020	179, 525	142, 216	131, 390
Total	1, 531, 212	1, 734, 479	2, 369, 906	2, 081, 336	2, 079, 770

The following statements regarding the local trade of Buffalo will be found of interest as showing the development of the business since 1842. The figures for years prior to 1886 were compiled by Mr. E. L. Hedstrom, of Buffalo; those for 1886, and subsequent years are furnished by Mr. William Thurston:

Coal receipts at Buffalo for several years.

Years.	Anthracite.	Bituminous.	Blossburg.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1842	....	....	....	1, 800
1852	....	....	....	57, 560
1862	....	....	....	239, 873
1872	....	....	....	790, 876
1882	....	....	....	3, 021, 791
1886	2, 673, 778	1, 420, 956	30, 000	4, 124, 734
1887	3, 497, 203	1, 776, 217	25, 000	5, 298, 420
1888	4, 549, 015	1, 892, 823	22, 500	6, 464, 338
1889	4, 338, 570	2, 198, 327	22, 500	6, 559, 397
1890	4, 500, 000	2, 200, 000	22, 500	6, 722, 500

Erie, Pennsylvania.—The shipments of coal from the city of Erie, Pennsylvania, during the past six years are reported as follows:

Coal shipments from Erie, Pennsylvania.

Years.	Tons.	Years.	Tons.
1883	204, 755	1887	230, 845
1884	193, 969	1888	245, 000
1885	188, 860	1889	300, 000
1886	235, 255	1890	498, 958

Cleveland, Ohio.—The prices of anthracite and bituminous coals at the close of 1889 and 1890 were as follows:

Price of coal at Cleveland, Ohio.

Kinds of coal.	1889.	1890.	Kinds of coal.	1889.	1890.
Bituminous:	*Per ton.*	*Per ton.*	Bituminous—continued:	*Per ton.*	*Per ton.*
Massillon	$2.40	$2.40	Coshocton	$2.00	$2.20
Palmyra	2.75	2.75	Hocking	1.90	2.00
Pittsburg	2.10	2.10	Anthracite:		
Salineville	1.70	1.70	Grate	4.53	5.00
Kentucky cannel	4.90	4.50	Egg	4.53	5.25
Goshen	1.90	1.75	Stove	4.78	5.25
Sherodsville	1.70	1.75	Chestnut	4.78	5.25
Osnaburg	1.80	1.85			

Coal and coke receipts and shipments at Cleveland, Ohio, for the past five years.

	1886.	1887.	1888.	1889.	1890.
Receipts:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bituminous	1,412,535	1,454,744	1,737,781	1,600,000	1,560,208
Anthracite	144,826	176,769	181,551	160,000	205,856
Coke	117,372	114,924	124,827	150,000	194,527
Total	1,674,733	1,746,437	2,044,159	1,910,000	1,960,591
Shipments:					
Anthracite by rail	20,000	20,296	29.785	25,000	29,056
Bituminous by rail	120.000	294,453	677,738	600,000	785,526
Bituminous by lake	600,000	703,506	1,000,000	1,100,000	1,200,000
Total	740,000	1,018,255	1,707,468	1,725,000	1,814,582

From the Cuyahoga customs district, which embraces Cleveland, Ashtabula, Fairport, and Lorain, the clearances during the past five years have been as follows:

Clearances from the Cuyahoga, Ohio, district for five years.

Years.	Tons.	Years.	Tons.
1886	1,079,784	1889	2,020,996
1887	1,433,035	1890	2,328,663
1888	1,855,260		

Toledo, Ohio.—The receipts of coal of all kinds in 1890 were 3,021,886 tons as against 2,838,314 tons in 1889, and 3,423,785 tons in 1888. Of the amount received in 1890, 133,813 tons, and of the 1889 receipts, 90,282 tons were anthracite, which came by lake.

Receipts of coal at Toledo, Ohio, for five years.

Received by—	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Wabash Railway	12,598	9,634	10,875	7,586	3,620
Lake Shore and Michigan Southern Railroad	165,382	206,099	101,064	35,698	20,592
Cincinnati, Hamilton and Dayton Railroad	8,198	11,741	37,831	51,746	25,753
Pennsylvania Company's railroad	201,427	330,020	339,750	234,675	214,765
Michigan Central Railroad	9,594	13,864	16,504	19,935	3,152
Columbus, Hocking Valley and Toledo Railway	1,039,200	955,620	1,358,025	923,745	931,717
Toledo, Ann Arbor and North Michigan Railway	1,910	552	24,700	96	....
Toledo, St. Louis and Kansas City Railroad	3,828	....	1,859	8,287	8,420
Toledo and Ohio Central Railway	404,684	590,000	687,000	706,950	826,049
Lake boats (*a*)	87,120	117,921	140,963	90,282	133,813
Wheeling and Lake Erie Railway	391,086	454,813	755,155	763,055	853,940
Toledo, Columbus and Southern Railway	15,832	5,446	1,014	1,210	....
Cincinnati, Jackson and Mackinaw Railroad	....	....	45	54	65
Total	2,340,859	2,695,710	3,423,785	2,838,314	3,020,886

a Anthracite.

Chicago, Illinois.—The following statistics exhibit the amount of coal and coke received at, shipped from, and consumed in, Chicago, Illinois, during seven years ending December 31, 1890:

Yearly receipts of coal at Chicago, Illinois.

Kinds of coal.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Anthracite by lake	820,002	741,886	768,164	853,158	1,242,044	1,283,811	1,228,358
Anthracite by rail	627,806	613,054	616,997	845,386	702,737	408,574	429,926
Eastern bituminous coal by lake	243,188	206,817	166,762	123,221	115,862	53,684	40,766
Eastern bituminous coal by rail	612,462	790,169	888,771	1,196,824	1,049,372	803,552	780,249
Illinois coal	1,467,989	1,287,995	1,175,001	1,375,759	1,809,210	1,797,096	1,801,817
Indiana coal	469,079	659,634	732,191	1,154,681	1,169,231	962,544	1,240,085
Coke	553,860	558,963	540,204	592,980	643,486	813,645	965,227
Total	4,794,386	4,858,518	4,888,090	6,141,509	6,731,942	6,122,906	6,486,428

The shipments, as shown in the following table, comprise coal and coke rebilled from this market or passing beyond Chicago on through billing.

Shipments of coal from Chicago, Illinois, for five years.

	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Anthracite	451,869	559,560	598,707	502,865	576,665
Bituminous coal and coke	539,184	1,001,477	872,631	703,743	951,678
Total	991,053	1,561,037	1,471,338	1,206,608	1,528.343

The following statement shows for each year the receipts and consumption of anthracite coal at, and shipments from, Chicago since 1884:

Anthracite coal receipts and consumption at Chicago, Illinois, from 1884 to 1890.

Years.	Receipts.				Distribution.			
	On hand in docks and yards Jan. 1.	Jan. 1 to Dec. 31.		Total.	Jan. 1 to Dec. 31.			Total.
		By vessel.	By rail.		Shipments to the country.	Local consumption.	Balance of stock carried over.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1884......	265, 645	820, 002	627, 806	1, 713, 453	585, 753	803, 411	324, 289	1, 713, 453
1885......	324, 289	741, 866	613, 054	1, 679, 209	632, 274	823, 417	223, 518	1, 679, 209
1886......	223, 518	768, 164	616, 997	1, 608, 679	451, 869	1, 038, 751	118, 059	1, 608, 679
1887......	118, 059	853, 158	845, 386	1, 816, 603	559, 560	1, 079, 443	177, 600	1, 816, 603
1888......	177, 600	1, 242, 044	702, 737	2, 122, 381	598, 707	1, 062, 315	461, 359	2, 122, 381
1889......	461, 359	1, 283, 811	408, 574	2, 153, 744	502, 865	1, 206, 520	444, 359	2, 153, 744
1890......	444, 359	1, 228, 358	429, 926	2, 102, 643	576, 665	1, 025, 978	500, 000	2, 102, 643

A review of the market conditions of 1889 shows that the anthracite trade was handicapped in the beginning by the largest stocks on hand ever known. In January the trade was practically lifeless, and, with the exception of a spurt or two occasioned by colder weather, this condition prevailed during the remainder of the winter and early spring. A more hopeful tone was apparent during April and May, but little actual improvement took place. The only real change for the better that occurred throughout the year was during the months of September, October, and November, which was followed by disappointment in December, the demand falling flat and the year closing with as unsatisfactory a record as has been known in the history of the trade.

Notwithstanding strikes among the miners in both Illinois and Indiana, prices of bituminous coal were reduced in January and continued to decline during the summer, but advanced again in the fall with trade active. During the prevalence of the strikes in some of the larger districts of Illinois and Indiana, which shut off a large source of Chicago's coal supply, the trade felt no particular inconvenience for the reason that other districts in the same States made up the loss, and shipments from other States, with the exception of West Virginia, instead of increasing during the mine troubles showed a decrease from former years.

The business of 1890, in both anthracite and bituminous circles, while not particularly profitable, was much more satisfactory than that of 1889. A general strike throughout the bituminous regions from the Alleghenies to the Mississippi was threatened during the spring, but after many conventions of operators and operatives the troubles were adjusted and a repetition of the disastrous difficulties of 1889 was averted. The districts of Indiana which suffered from the previous strike recovered the ground lost and shipped large quantities of coal.

The following statement shows the prices of different coals at Chicago at the close of 1890:

Prices of coal and coke at Chicago, Illinois, at the close of 1890.

Kinds of coal.	Per short ton.	Kinds of coal.	Per short ton.
Winifred, West Virginia	$3.75	Pana	$2.00
Raymond, West Virginia	3.75	Streator	2.00
Plymouth, West Virginia	3.75	Girard	1.90
Pittsburg	3.30	Wilmington	2.10
Youghiogheny	3.40	Springfield	2.00
Hocking Valley	3.30	Decatur Erie big vein	2.15
Shawnee	3.30	Colfax lump	1.80
Sunday Creek	3.30	Elk Creek	2.60
Little Muddy	2.60	Chattaroi cannel	5.00
Jackson Hill, Ohio	3.45	Brush Creek cannel	4.25
Brazil block	2.50	Birdseye cannel	5.00
Norton Creek	2.10	Sonman smithing	3.65
New Pittsburg	1.90	Cumberland smithing	3.75
Clinton	1.90	Blossburg	3.90
Erie and Brier Hill	4.25	Connellsville coke (foundry)	5.20
New Kentucky lump	2.80	Connellsville coke (crushed)	5.40
New Kentucky mine run	2.40	Walston coke	5.20
Mount Olive	2.10		

ANTHRACITE (*a*).

Lehigh lump	$6.47	Grate	$5.50
Stove	5.75	Egg	5.75
Chestnut	5.75		

(*a*) Free on board cars in Chicago.

Milwaukee, Wisconsin.—The following are the total receipts of coal at the port of Milwaukee for the season of navigation during 1890:

Coal receipts at Milwaukee in 1890.

	Anthracite.	Bituminous.	Totals.
	Short tons.	*Short tons.*	*Short tons.*
Northwestern Fuel Co	120,194	46,757	166,951
Coxe Brothers & Co	72,771	28,843	101,614
H. M. Benjamin	89,519	47,811	137,330
R. P. Elmore & Co	42,928	6,581	49,509
Pennsylvania Coal Co	18,967	1,036	20,003
Corrigan & Co	6,802	3,954	10,756
Buell & Pynchon		9,632	9,632
F. R. Buell & Co	34,563	1,168	35,731
The Hadfield Co	53,366	1,440	54,806
L. Henes, jr. & Co	10,968	26,930	37,898
Silver Creek Coal Co	19,760	27,952	47,712
B. Urigh & Son	12,471	1,861	14,332
Gross & Sons	13,400		13,400
N. A. Nelson	7,545		7,545
Lehigh and Franklin Coal Co	24,233	49,268	73,501
J. H. Pauly	9,683	3,721	13,404
Daniel Orth & Son	7,519	528	8,047
Husse & Raloff	4,578		4,578
Callaway & Co	3,296		3,296
Whitnell & Rademaker	6,334		6,334
Joachim Christiensen	4,165		4,165
John Hannan			
Milwaukee Gas Light Co		29,171	29,171
Krause & Co., Milwaukee		3,161	3,161
Milwaukee Coal Co	4,325		4,325
Illinois Steel Co		13,681	13,681
Cudahay Brothers		4,319	4,319
Jupiter Mills		604	604
Sandersens' Mill		1,915	1,915
Schlitz Brewing Co		12,027	12,027
Miscellaneous	5,905	8,884	14,789
	573,292	331,244	904,536
Summary:			
Anthracite			573,292
Bituminous			331,244
Total			904,536

The following tables have been compiled and reported to the Survey by Mr. William J. Langson, secretary of the chamber of commerce:

Receipts of coal at Milwaukee for six years.

	1885.	1886.	1887.	1888.	1889.	1890.
By lake from—	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Buffalo	392,003	395,971	461,972	631,263	542,167	510.598
Erie	50,915	41,847	61,222	74,610	47,862	46,378
Oswego	10,043	....	1,153	1,348	....	2,408
Cleveland	126,741	91,997	78,259	98,631	89,071	135,413
Ashtabula	35,360	11,096	38,881	23,105	48,599	24,671
Black River	5,549	....	....	....	....	....
Lorain	19,452	12,417	11,757	13,533	15,367	15,351
Sandusky	19,307	57,412	36,606	19,733	51,816	26,193
Toledo	31,875	69,079	14,115	38,452	71,516	59,305
Charlotte	19,491	31,744	2,781	14,292	22,526	6,120
Fairport	....	....	10,517	30,253	5,552	11,100
Ogdensburg	....	....	....	7,700	4,953	7,026
Huron, Ohio	....	....	....	8,244	7,726	9,720
Other ports	....	2,679	4,331	....	588	[a]49,375
Total by lake	710,736	714,242	724,594	961,164	907,743	903,658
By railroad	65,014	45,439	118,385	161,079	72,935	92,909
Total receipts	775,750	759,681	842,979	1,122,243	980,678	996,657

[a] Including cargoes from all ports not reported at the custom-house.

Shipments of coal from Milwaukee for the past eight years.

Shipped by—	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago, Milwaukee and St. Paul Railway	146,295	140,630	179,883	177,286	166,120	283,269	258,281	378,090
Chicago and Northwestern Railway	41,746	37,314	56,591	70,420	79,258	107,193	97,207	103,279
Wisconsin Central Railroad	6,725	7,469	8,943	11,745	18,953	12,624	11,727	15,929
Milwaukee, Lake Shore and Western Railway	30,575	11,757	12,804	13,072	13,886	16,146	25,413	5,884
Milwaukee and Northern Railroad	10,075	7,556	10,872	12,011	15,627	34,480	20,556	19,386
Lake	355	335	184	269	1,595	125	224	56
Totals	235,771	205,061	269,277	284,803	295,439	453,837	413,408	522,618

Receipts of coal at Milwaukee, by lake and rail annually, for twenty-nine years, from 1862 to 1890, inclusive.

Years.	Tons.	Years.	Tons.
1862	21,860	1877	264,784
1863	43,215	1878	239,667
1864	44,503	1879	350,840
1865	36,369	1880	368,568
1866	66,616	1881	550,027
1867	74,568	1882	593,842
1868	92,992	1883	612,584
1869	87,690	1884	704,166
1870	122,865	1885	775,750
1871	175,526	1886	759,681
1872	210,194	1887	842,979
1873	229,784	1888	1,122,243
1874	177,655	1889	980,678
1875	228,674	1890	996,657
1876	188,444		

Duluth, Minnesota, and Superior, Wisconsin.—A marked spirit of rivalry exists between these cities, and it is somewhat difficult to get at the exact facts regarding business done at both places. During 1889 Superior increased its facilities by the addition of the Eastern Minnesota coal dock; and Duluth by the opening of the Wilmar and Sioux Falls road, was able to ship through to Iowa and South Dakota. In addition to this the railroads reaching points covered by Chicago and Milwaukee dealers made rates from Duluth which enabled that city to compete with the others for the lake coal trade. In spite of these favorable conditions, however, the aggregate receipts of coal at the two cities were 330,000 tons less than in 1888. But in the following year the benefits became evident, for the receipts increased 575,995 tons over 1889, and 245,995 tons over the best previous year, 1888.

It is interesting to note the development of the coal trade at the head of the lakes (1889 being the only exception to the steady increase of business), and the following figures give total receipts in tons each season for the past ten years. Every settler on the prairies of the Northwest makes a new customer for Duluth coal, and the increased traffic is evidence of the great development going on.

Coal receipts at Duluth, Minnesota.

Years.	Tons.	Years.	Tons.
1878	31,000	1886	736,000
1881	163,000	1887	912,000
1882	260,000	1888	1,535,000
1883	420,000	1889	1,205,000
1885	595,000	1890	1,780,995

St. Paul and Minneapolis, Minnesota.—Wholesale prices for coal were as follows in December, 1890:

Prices of coal at St. Paul and Minneapolis, Minnesota, in December, 1890.

	Free on board cars at Duluth.	To dealers at St. Paul and Minneapolis.
Anthracite:		
Grate	$5.00 to $5.50	$6.75
Egg, stove, and nut	5.25 to 5.75	7.00
Pea	3.75 to 4.00	5.25
Bituminous:		
Pittsburg	3.75	4.75
Youghiogheny	3.75	4.75
Kincaid	3.50	4.50
Mansfield	3.75	4.75
Hocking	3.50	4.50
Wheeling Creek	3.50	....
Briar Hill	4.25	5.25
Smithing:		
Cumberland	4.25	5.25
Blossburg	4.25	5.25

Cincinnati, Ohio.—Col. S. D. Maxwell, superintendent of the Cincinnati Chamber of Commerce, in his annual report states that the coal trade of the city for 1889 and 1890 was generally unfavorable. The warm weather which prevailed throughout the winter of both years reduced local consumption, and the market was tormented during nearly the whole of the time by supplies in excess of demand. Col. Maxwell reports the following receipts of coal at Cincinnati for ten fiscal years ending August 31:

Coal receipts at Cincinnati, Ohio.

Years.	Tons.	Years.	Tons.
1881	1,492,817	1886	2,130.354
1882	2,197,407	1887	2,350,026
1883	2.025,859	1888	2,551,415
1884	2,092,551	1889	2,348,055
1885	2,008,850	1890	2,452,253

Prices of coal at Cincinnati, Ohio, at the close of 1890.

Anthracite coal.	Free on board car.	Delivered.	Bituminous coal.	Free on board car.	Afloat, per bushel.
	Short tons.	*Short tons.*		*Short tons.*	*Cents.*
Chestnut	$5.75	$6.50	Youghiogheny	$2.25	6¼ to 7¼
Stove	5.75	6.50	Kanawha River	2.25	6 to 6½
Grate	5.50	6.50	Nut and slack	1.40	4
Egg	5.50	6.50			

Louisville, Kentucky.—The following table shows the consumption of coal in the vicinity of Louisville during the past six years. The figures do not include coal used by railroads. The receipts of coke are partly estimated on account of incomplete returns.

Consumption of coal in the vicinity of Louisville, Kentucky, for six years.

	1885.	1886.	1887.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Pittsburg by river	539,628	575,000	646,000	750,000	800,000	640,000
Ohio and Kanawha rivers	86,348	90,000	72,800	95,000	100,000	120,000
Total coal by river	625,976	665,000	718,800	845,000	900,000	760,000
Bituminous by rail	305,960	200,671	232,107	341,427	298,118	304,399
Anthracite	9,300	4,341	4,241	13,377	6,740	2,846
Coke	40,306	50,000	49,688	65,000	50,000	50,000
Aggregate	981,542	920,012	1,004,836	1,264,804	1,254,858	1,117,245

Saint Louis, Missouri.—The following prices were quoted free on board, East Saint Louis, at the close of 1890:

Prices of coal at Saint Louis, Missouri, at the close of 1890.

Bituminous.	Per short ton.
Big Muddy	$1.87½
Vulcan and Superior	1.87½
Trenton	1.62½
Brookside	1.50
Troy and St. Barnard	1.37½
Standard, Illinois	1.18¾
Piedmont, smithing	4.10
Blossburg, smithing	3.95
Connellsville coke	5.55
Anthracite (*a*).	**Per long ton.**
Large egg, for 2½ tons and upward	$7.50
Egg, stove and nut, for 2½ tons and upward	7.75

a Retail, delivered in St. Louis.

The receipts of anthracite and bituminous coal and of coke for 1889 and 1890 are shown in the following table, together with the receipts for the three previous years. They show that the receipts of bituminous coal decreased 448,711 tons, or 19 per cent. in 1889, and that anthracite receipts fell off 14,760 tons, or about 11 per cent., from either of which there was only a slight recovery in 1890. The receipts of coke increased each year, but in neither reached the same amount quoted for 1887.

Receipts of coal at Saint Louis, Missouri, in 1886, 1887, 1888, 1889, and 1890.

Years.	Bituminous coal.	Anthracite coal.	Coke.
	Tons.	*Tons.*	*Tons.*
1886	2,082,019	96,640	104,036
1887	2,321,814	131,600	175,550
1888	2,357,938	136,290	134,660
1889	1,909,227	121,530	147,750
1890	1,915,960	124,335	162,940

Kansas City, Missouri.—Quotations for short tons on the cars, delivered here, were as follows:

Prices of coal at Kansas City, Missouri, at the close of 1890.

	Per ton.		Per ton.
Bituminous:		Bituminous—Continued.	
Farmers' lump	$2.50	Foster lump	$2.25
Weir City nut	2.00	Wellington	2.40
Oakdale nut	2.50	Semi-anthracite	4.50
Rich Hill nut	1.75	Anthracite:	
Higginsville lump	2.30	Nut size	8.75
Clinton lump	2.25	Egg size	8.50
Deepwater lump	2.25	Stove size	8.75
Cannel	4.75	Grate size	8.50
Illinois	2.50–3.00	Smithing coal:	
Vernon	2.37½	Piedmont	6.25
Weir City lump	2.50	Blossburg	6.25
Oakdale lump	2.50	Coke:	
Rich Hill lump	2.37½	Gas house	4.50
Lexington lump	2.40	Native	4.00
Excelsior lump	2.50	Connellsville	7.00

The receipts and shipments for the last six years have been as follows:

Coal receipts and shipments at Kansas City for six years.

	Receipts.	Shipments.		Receipts.	Shipments.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1885	533,262	199,476	1888	935,735	174,197
1886	562,540	160,233	1889	1,260,816	269,281
1887	752,354	134,550	1890	1,149,253	385,000

Mobile, Alabama.—With the exception of a small amount of anthracite, all of the coal received at Mobile comes from the Alabama mines, but high freight rates from the mines have as yet prevented the port becoming of much importance as a shipping point. Government improvements now being made in the Warrior and Coosa rivers are expected to make direct water routes to the mines, and effect a material reduction in freight rates. If these hopes are realized coal will be put down in Mobile at $1 per ton less than at present; that is, from $3 to $2 per ton. Coal business is reported as having been in an unsatisfactory condition for three years. In December, 1890, when there was a better demand for coal than at any time during the period mentioned, the Alabama miners went out on a strike, and coal became very scarce.

Following will be found the amounts of coal received at Mobile for the past eight years. These figures do not include the coal consumed by the Louisville and Nashville and the Mobile and Ohio railroads, which amounts to about 25,000 tons annually.

Receipts of coal at Mobile, Alabama, for eight years.

Years.	Alabama coal.	Anthracite and English.	Years.	Alabama coal.	Anthracite and English.
1883	25,304	1,229	1887	39,232	910
1884	17,808	891	1888	38,785	648
1885	40,301	775	1889	40,000	500
1886	30,310	2,022	1890	45,000	500

New Orleans, Louisiana.—A comparative statement of consumption of Pittsburg coal is given below:

Consumption of Pittsburg coal at New Orleans, Louisiana, from 1883 to 1890.

Years.	Barrels.	Years.	Barrels.
1883	3,759,250	1887	5,100,000
1884	3,864,300	1888	4,500,000
1885	3,995,650	1889	4,846,500
1886	4,529,000	1890	4,750,000

The coal sent to planters below the city is included in the consumption. The returns for 1886 and following are for calendar years; the preceding years end November 30. The Pittsburg and Southern Coal Company ceased to exist at the close of 1889, owing to dissensions among the members. This organization was mentioned in the report for 1888 as having been effected by Pittsburg coal shippers for handling their coal in New Orleans. The method of measuring coal by the barrel at New Orleans still continues, the barrel weighing 208 pounds and containing 2.6 bushels. Prices of Pittsburg coal ranged about 25 cents per barrel during 1890, which was less than for some years previous.

California.—The following table exhibits the various sources from which California has received its coal during 1888, 1889, and 1890, and the tons imported from each locality:

Imports of coal at San Francisco.

	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*
British Columbia (Wellington, Nanaimo, and East Wellington)	304,916	381,460	345,252
Australian	272,336	303,285	155,306
English and Welsh	107,387	43,678	40,829
Scotch	10,510		
Eastern (Cumberland and anthracite)	30,120	21,588	32,684
Franklin, Green River, and Cedar River	322,711	198,853	195,770
Carbon Hill and South Prairie	241,437	191,775	247,720
Mount Diablo and Coos Bay	81,194	49,770	53,991
Japan	15,852	4,540	13,170
Rocky Mountains	....	1,594	....
Other sources	....	....	850
Total	1,386,463	1,196,543	1,085,572

The arrivals at San Pedro and San Diego are not included in the above table. The following table shows the receipts at San Diego from 1886 and at San Pedro from 1888:

Receipts of coal at San Diego and San Pedro, California.

	1886.	1887.	1888.	1889.	1890.
San Diego	20,986	68,996	101,368	54,800	52,358
San Pedro	....	....	166,214	66,740	70,954

Prices for all coals during 1889 were widely fluctuating, but ruled generally low. In 1890 the demand was generally greater than the supply and prices were high, the year proving a profitable one to all engaged in the trade and especially to operators of Pacific coast mines. The scarcity of coal during 1890 was due to the great strike in Australia, which cut off an important source of supply. The strike at the Wellington mine, British Columbia, also affected receipts. The coal from this mine is of the finest produced on the coast and has always been in high demand. The vein is from 7 to 8 feet thick and the mine has a daily capacity of 950 tons, which is being increased as rapidly as possible.

Total receipts of coal at San Francisco during the past eight years.

Years.	Tons.	Years.	Tons.
1883	869,615	1887	1,154,993
1884	987,151	1888	1,386,463
1885	959,246	1889	1,196,543
1886	1,011,867	1890	1,085,572

The average wholesale price of Wellington coal at San Francisco is $9 per ton, but the scarcity in December put the price up to $12 per ton. Australian coal, which sold at $6.75 per ton in January, 1890, rose to $11.50 per ton in December. The closing prices for the year were as follows:

Prices of coal at San Francisco at the close of 1890.

To arrive.	Per ton.	Spot, from yard.	Per ton.
West Hartley	$10.00	Wellington	$10.50
Scotch splint	10.00	Seattle	11.00
Cardiff	13.00	Coos Bay	11.00
Lehigh, lump	19.00	Cannel	11.00
Cumberland, bulk	17.00	Egg, hard	19.00
Egg, hard	18.00	Cumberland, bulk	18.00

WAGES IN COAL MINING.

The rate of wages paid to employés in and about coal mines continues to be a matter of dispute between the employer and the employed, and appearances do not seem favorable to the formation of a coöperative system whereby the interests of operator and miner may be mutually subserved. Strikes are of almost constant occurrence in one part the country or another, and no annual report of the industry can be written without mentioning some section which has been seriously injured from this cause. The miners, led frequently by some agitator rather than by reason, will not submit to a reduction of wages when the state of the market renders a curtailment of mining expenses necessary, and go out on a strike, causing loss of trade to their employers and bringing want to their own doors.

The average scale of wages paid to miners and other employés about the mines varies considerably in different parts of the country, depending largely, as it does, on the law of supply and demand, and, to a considerable extent, on the distance from trade centers and the cost of living in the particular section. The census returns show that the average wages paid miners in 1889 varied from $1.46 per day in North Carolina and Georgia to $3.26 per day in Washington. In most of the more important coal-producing States the miners are paid by the ton, bushel, or miner's car, the latter being an irregular quantity, though containing usually about 1,500 or 1,600 pounds.

In compiling the census tables on miners' wages it was deemed advisable to make them as uniform as possible with the wages of other employés, that is, by the rate of their daily earnings instead of by the rate per ton paid for mining. The census tables are reproduced below. No attempt has been made to obtain statements of wages from operators for 1890.

Labor and wages at coal mines of the United

States and Territories.	Above ground.												
	Foremen or overseers.			Mechanics.			Laborers.			Boys under 16 years.			Total average number employed.
	Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.	
Alabama	57	$2.52	276	123	$2.12	231	797	$1.25	218	41	$0.62	212	1,018
Arkansas	5	2.69	248	21	2.22	208	79	1.49	210	11	.70	159	116
California and Oregon	6	5.12	296	20	2.90	236	48	2.04	248	2	1.50	240	76
Colorado	53	3.50	278	161	2.98	229	571	2.21	234	22	1.25	221	807
Georgia and North Carolina	12	2.29	264	34	2.15	210	277	.96	255	6	.45	24	329
Illinois	217	2.34	262	625	2.03	266	1,678	1.52	201	64	.80	200	2,584
Indiana	74	2.36	255	160	1.84	256	426	1.47	192	6	.71	152	666
Indian Territory	11	2.55	291	63	2.50	170	145	1.90	164	1	1.00	250	220
Iowa	147	2.20	228	202	2.23	253	709	1.57	209	17	.78	169	1,075
Kansas and Nebraska	69	2.37	190	160	2.23	200	488	1.56	197	25	.77	156	742
Kentucky	76	2.44	270	152	1.81	242	627	1.30	204	38	.75	205	893
Maryland	15	3.04	266	65	2.03	264	225	1.59	196	16	.90	187	321
Michigan	7	2.11	199	11	1.92	213	28	1.93	249	......	......	.....	46
Missouri	122	2.09	228	107	2.11	246	692	1.52	214	29	.80	181	950
Montana	9	5.26	251	38	3.58	252	123	2.50	240	1	2.00	300	171
New Mexico	13	3.27	208	26	2.88	231	112	2.37	213	6	1.07	188	157
North Dakota	7	2.29	115	3	2.67	88	3	1.50	100	......	......	.....	13
Ohio	221	2.26	244	334	1.91	235	1,420	1.51	192	83	.77	187	2,058
Pennsylvania (anthracite)	564	2.71	291	4,720	1.92	257	23,779	1.29	198	17,091	.62	185	46,154
Pennsylvania (bituminous)	378	2.57	250	1,028	2.11	237	3,366	1.67	208	207	.86	200	4,979
Tennessee	48	2.46	249	101	1.86	244	393	1.21	222	27	.55	190	569
Texas	7	2.91	283	5	2.50	260	109	1.52	248	......	......	.....	121
Utah	3	3.63	246	18	2.84	238	59	2.35	198	4	.97	252	84
Virginia	16	2.01	245	51	1.77	209	407	1.16	282	47	.47	210	521
Washington	21	3.76	293	94	3.04	255	396	2.29	242	29	1.41	214	540
West Virginia	117	2.48	270	244	1.90	246	1,135	1.36	211	62	.76	203	1,558
Wyoming	10	4.42	263	37	2.97	269	321	2.21	253	1	1.50	156	309
Total	2,285	......	.....	8,603	......	.....	38,413	......	.....	17,836	......	.....	67,137

States in 1889, by States and Territories.

Below ground.														Total employés about mine.	Total amount of wages paid during 1889.
Foremen or overseers.			Miners.			Laborers.			Boys under 16 years.			Total average number employed.			
Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.	Average number employed.	Average wages per day.	Average number of days worked.				
73	$2.73	272	4,110	$2.15	248	1,564	$1.33	237	99	$0.66	224	5,846	6,864	$3,157,109
10	2.71	228	462	2.20	180	64	2.00	186	25	.72	199	561	677	248,899
9	3.17	271	235	2.58	224	85	2.32	268	8	1.47	239	337	413	241,249
46	3.36	287	3,390	2.67	212	564	2.65	214	97	1.18	220	4,097	4,904	2,734,895
13	1.64	210	271	1.46	291	120	.98	288	......	......	.....	404	733	258,016
305	2.38	256	15,386	1.98	177	5,062	1.77	199	597	.90	176	21,350	23,934	8,429,553
135	2.36	170	4,738	1.89	175	820	1.70	182	89	.71	184	5,782	6,448	2,144,566
10	3.10	252	1,200	3.25	166	393	2.41	177	39	.88	198	1,642	1,862	915,567
139	2.46	251	6,588	2.23	196	1,191	1.89	217	254	.77	200	8,172	9,247	3,860,893
103	2.46	230	4,447	1.89	207	456	1.75	222	208	.88	219	5,214	5,956	2,258,485
59	2.33	255	3,406	1.75	193	674	1.56	219	112	.70	213	4,251	5.144	1,669,524
22	3.04	289	2,689	2.45	203	386	1.86	222	284	1.06	200	3,381	3,702	1,700,305
4	2.31	218	191	1.74	184	10	1.67	216	10	.87	300	215	261	90,124
103	2.33	230	4,780	2.10	201	656	1.81	206	142	.71	203	5,681	6,631	2,476,870
11	4.32	248	521	3.19	213	143	2.60	235	2	1.50	300	677	848	576,773
9	3.58	287	688	3.08	192	146	2.59	207	15	1.10	105	858	1,015	584,376
3	3.00	117	55	2.15	108	4	1.88	111	......	......	.....	62	75	17,560
221	2.32	245	14,733	1.95	181	1,955	1.63	185	376	.73	181	17,285	19,343	6,730,778
737	3.05	291	36,739	2.40	179	35,376	1.63	184	4,770	.89	180	77,522	123,676	38,867,331
606	2.56	256	40,100	1.93	210	5,303	1.85	220	2,144	.78	217	48,153	53,132	20,327,805
55	2.13	245	2,538	1.98	227	696	1.26	228	173	.71	229	3,462	4,031	1,548,392
6	2.65	248	340	2.00	264	56	1.77	236	20	.75	40	422	543	252,470
5	3.47	260	332	3.21	163	101	2.5[illegible]	169	29	1.00	168	467	551	258,601
12	2.44	265	712	1.53	285	253	1.59	269	25	1.14	274	1,002	1,523	604,796
31	3.97	286	1,549	3.26	197	509	2.46	222	28	1.06	222	2,117	2,657	1,696,293
118	2.46	269	6,367	1.86	223	1,504	1.47	224	231	.66	220	8,220	9,778	3,748,721
14	3.31	310	1,593	2.71	231	680	2.47	220	19	1.32	238	2,306	2,675	1,537,107
2,859	......	....	158,060	......	....	58,771	......	....	9,796	......	.....	229,486	296,623	106,937,058

DETAILED STATISTICS, BY STATES.

ALABAMA.

Total product in 1889, 3,572,983 short tons; spot value, $3,961,491. Total product in 1890, 4,090,409 short tons; spot value, $4,202,469.

In no other State have such rapid strides been made in the production of coal as in Alabama during the past decade. At the time of the taking of the Ninth Census (1870) no coal was being mined in the State except for local consumption. During the next ten years the production increased to a limited extent, amounting in 1880 to 340,000 tons. During 1886 and 1887 Birmingham experienced the great development due to the discovery of valuable coal and iron deposits in the neighborhood, and in the latter year the production of coal was increased to 1,950,000 tons. Another million tons was added to the product in 1888. In 1889 the product was 3,572,983 short tons, worth $3,961,491, and in 1890, 4,090,409 short tons, valued at $4,202,469.

The following tables show, by counties, the production of coal in Alabama in 1889 and 1890, also the distribution of the product. In previous volumes of Mineral Resources tables have been published showing the returns from individual mines in Alabama. The individual returns for 1889 were collected by the Census Office under the stipulation that they would be held strictly confidential. The same plan has been adopted in collecting the statistics for 1890, hence no statements of individuals are given.

Coal product of Alabama in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Bibb	363, 102	1, 414	17, 590	118, 419	500, 525	$604, 230
Blount	....	164	....	....	164	273
Cherokee	....	40	....	....	40	80
Cullman	....	300	....	....	300	600
Etowah	....	4, 751	....	....	4, 751	8, 325
Jefferson	1, 399, 264	40, 577	49, 208	948, 397	2, 437, 446	2, 618, 777
St. Clair	21, 922	1, 170	2, 840	14, 625	40, 557	50, 518
Shelby	54, 361	327	5, 272	24, 873	84, 833	152, 166
Tuscaloosa	8, 600	6, 991	550	....	16, 141	19, 796
Walker	479, 960	4, 211	4, 055	....	488, 226	506, 726
Total	2, 827, 209	59, 945	79, 515	1, 106, 314	3, 572, 983	3, 961, 491

Coal product of Alabama in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Bibb	365,742	1,440	24,141	130,488	521,811	$574,419	250	1,340
Coosa	22,000	750	3,903	7,000	33,653	39,855	188	175
Jefferson	1,294,882	31,292	52,478	1,286,408	2,665,060	2,669,226	267	(*a*)6,209
Shelby	25,022				25,022	62,550	200	150
Tuscaloosa	60,521	3,936	1,060		65,517	68,795	157	268
Walker	719,816	35,160	7,370	5,000	767,346	768,624	210	1,500
Small mines		12,000			12,000	19,000		
Total	2,487,983	84,578	88,952	1,428,896	4,090,409	4,202,469	(*b*)217	10,642

a Includes 1,350 convicts leased by the State.

b Average for the State.

PRODUCTION, BY DISTRICTS.

The coal fields of Alabama are divided into three districts, namely: The Warrior, embracing the counties of Tuscaloosa, Walker, and a portion of Jefferson; the Cahaba, embracing the counties of Bibb, Shelby, and the remainder of Jefferson; and the Coosa, covering St. Clair county. The product in 1890, by districts, is shown in the following table:

Coal product of Alabama in 1890, by districts.

Districts.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Cahaba	561,764	10,440	34,141	480,488	1,086,833	$1,068,969	2,190
Coosa	22,000	750	3,903	7,000	33,653	39,855	175
Warrior	1,904,219	61,388	50,908	941,408	2,957,923	3,074,645	8,277
Small mines		12,000			12,000	19,000	
Total	2,487,983	84,578	88,952	1,428,896	4,090,409	4,202,469	10,643

LABOR AT ALABAMA COAL MINES.

During 1889 the average number of men employed at Alabama coal mines was 6,975. They worked an average of about 248 days. In 1890 10,642 men were employed, and the average number of days the collieries were active was 217. It is difficult to arrive at the average number of days worked per man, as accounts are not kept in a manner to admit of easily obtaining such a statement, and operators naturally object to taking the time and trouble necessary for such work. A company carrying 300 men upon its pay roll may be operating, say, 250 days in the year. Few miners, however, work more than five days a week, and it is probable that the average would be little more than four days per week per man. Hence, in the foregoing tables the average is given of the number of days the collieries were operating, which is larger than the number of days worked per man. The number of men employed includes superintendents, foremen, mechanics, and all others employed in and about the mines. Of the number of employès, 1,350 were convicts.

ARKANSAS.(*)

Total product in 1889, 279,584 short tons; spot value, $395,836. Total product in 1890, 399,888 short tons; spot value, $514,595.

Coal mining in Arkansas as an industry of commercial importance is of recent date. Practically no coal was mined in the State up to 1870, though it has been stated some coal was taken out in that year. The Tenth Census (1880) reported a product of 14,778 short tons, valued at the mines at $33,535. At this time the coal mines gave employment to a total force of 130 persons. At the time of taking the Eleventh Census 677 persons were employed in the production of 279,584 short tons. In the year 1890, 938 men were employed.

The product of 1889 was 2,713 short tons more than that of 1888. The increase in 1890 over that of 1889 was 120,304 short tons. The increase in value was $118,659, showing that the increase in the volume of production was attended by a decrease in the price received at the mines.

The coal product of Arkansas, by counties, for 1889 and 1890, with the distribution of the product, is shown in the following tables:

Coal product of Arkansas in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*		
Franklin	....	1,688	....	1,688	$4,125	....
Johnson	103,018	1,080	1,900	105,998	156,067	172
Pope	4,214	1,200	600	6,014	11,491	
Sebastian	161,286	2,852	1,746	165,884	224,153	505
Total	268,518	6,820	4,246	279,584	395,836	677

Coal product of Arkansas in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Sebastian	285,268	1,290	14,330	300,888	$363,668	214	683
Johnson	85,900	1,800	1,300	89,000	130,927	215	215
Pope	3,801	150	49	4,000	8,000	200	40
Small mines	....	6,000	....	6,000	12,000	....	....
Total	374,969	9,240	15,679	399,888	514,595	(*a*)214	938

a Average for the State.

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* In the 1888 volume of Mineral Resources was published a detailed description of the Arkansas coal fields, prepared by Mr. Arthur Winslow, assistant geologist in charge of coal regions.

The production of coal in Arkansas from 1882 to 1890 has been as follows:

Product of coal in Arkansas from 1882 to 1890.

Years.	Short tons.	Years.	Short tons.
1882	5,000	1887	129,600
1883	50,000	1888	276,871
1884	75,000	1889	279,584
1885	100,000	1890	399,888
1886	125,000		

In "Mineral Resources of the United States, 1887," the coal product of Arkansas for that year was estimated at 150,000 short tons. Later returns, however, showed that this estimate was entirely too high, and in the volume for 1888 the amount is given as 129,600 short tons. It is probable that estimates for previous years are also excessive, with the possible exception of 1882.

Transportation facilities.—The product of Sebastian county is shipped over the Saint Louis, Iron Mountain and Southern railroad from Jenny Lind, and over the Saint Louis and San Francisco railroad from Huntington. The colliery at Hackett, on the line of the Saint Louis and San Francisco railroad, shipped 17,643 tons in 1889, but was not in operation in 1890. The product of Johnson and Pope counties is shipped over the Little Rock and Fort Smith railroad from Coal Hill and Will Creek.

Markets.—The larger portion of the shipments from Huntington are made to Texas, though Kansas and Arkansas take a part of the supply. The Jenny Lind properties supply the neighboring cities and towns with coal for domestic use, and the Saint Louis, Iron Mountain and Southern railroad with fuel for locomotives. The Allister and Coal Hill slopes at Coal Hill supply fuel to the Missouri, Kansas and Texas railroad for its locomotives. The greater part, probably 80 per cent. of the total product, is used for steaming purposes, the remainder being used for domestic consumption in Hot Springs, Van Buren, and other points in the State. The coal from Will Creek is used almost entirely for domestic purposes. It is shipped to Little Rock, Van Buren, Russellville, Hot Springs and Memphis.

Composition.—The following analyses and descriptions of Arkansas coals, made in the geological survey of the State by Dr. R. N. Brackett and Mr. J. P. Smith, were published in Mineral Resources for 1888, and on account of the exhaustion of that volume are repeated here.

Analyses of Arkansas coals (a).

Names of mines.	Counties.	Thickness. Ft.	Thickness. In.	How sampled.	Specific gravity.
Hackett City shaft	Sebastian	3	0	From 5 market cars	1.341
Huntington slope	....do	6	6	From 2 market cars	1.293
Greenwood shaft	....do	6	0	From pile of fresh coal on dump.	1.300
Gwyn drift	....do	4	10	......do	1.315
Western Coal and Mining Company, Petty slope.	....do	5	0	......do	1.384
Philpott shaft	Johnson	1	9	......do	1.292
Felker slope	Franklin	1	8	From pile on dump, dug six months.	1.617
Ouita slope	Pope	2	6	From 1 market car	1.339
Eureka shaft	Johnson	3	0	......do	1.345
Coal Hill shaft	....do	3	10	......do	1.333
Allister slope	....do	3	7	From 2 market cars	1.320
Shinn slope	Pope	1	10	From fresh face of coal	1.346

Names of mines.	Counties.	Chemical composition.					Fuel ratio.
		Water.	Sulphur.	Ash.	Fixed carbon.	Vol. hydrocarbon.	$\frac{C.}{V.H.C.}$
Hackett City shaft	Sebastian	0.853	1.324	9.038	73.869	14.916	4.95
Huntington slope	....do	0.928	1.143	4.845	77.538	15.546	4.99
Greenwood shaft	....do	0.818	2.522	5.973	75.821	14.866	5.10
Gywnn drift	....do	0.892	1.193	6.245	77.092	14.577	5.29
Western Coal and Mining Company, Petty slope.	....do	1.779	1.620	7.046	76.225	13.330	5.72
Philpott shaft	Johnson	0.869	0.993	3.090	80.915	14.133	5.73
Felker slope	Franklin	1.128	1.164	3.220	81.277	13.211	6.15
Ouita slope	Pope	0.980	1.829	8.174	76.817	12.200	6.29
Eureka shaft	Johnson	1.100	2.745	12.042	72.835	11.278	6.46
Coal Hill shaft	....do	1.017	3.672	8.351	76.119	10.841	7.02
Allister slope	....do	1.178	3.531	8.322	76.494	10.475	7.30
Shinn slope	Pope	1.058	3.346	11.750	75.434	8.410	8.96

Names of mines.	Counties.	Results of coking tests.	
		Appearance of product.	Per cent of product.
Hackett City shaft	Sebastian	Product well fused and roughly took the shape of the crucible.	82.3
Huntington slope	....do	Product well fused and took the shape of the crucible.	80.6
Greenwood shaft	....do	Product very well fused and took the shape of the crucible.	83.6
Gwyn drift	....do	......do	82.2
Western Coal and Mining Company, Petty slope.	....do	Product well fused and took roughly the shape of the crucible.	83.0
Philpott shaft	Johnson	Product, well fused and took the shape of the crucible.	84.6
Felker slope	Franklin	Fragments partially fused, but retain somewhat the original shapes.	85.0
Ouita slope	Pope	Product not at all fused; fragments retain their original shapes.	87.6
Eureka shaft	Johnson	......do	89.2
Coal Hill shaft	....do	Product partially fused; fragments retain somewhat their original shapes.	87.2
Allister slope	....do	Product partially fused; fragments little changed.	86.5
Shinn slope	Pope	Product not at all fused; fragments retain their original shapes.	88.4

a Arranged in the order of their fuel ratios.

On the basis of their fuel ratios, it is seen that the above coals are mostly semi-bituminous. The term "semi-anthracite" is often somewhat carelessly applied to all Arkansas coals. The physical appearance of the different varieties is similar, which, together with the fact that in composition they merge into each other by almost insensible gradations, has rendered confusion in nomenclature excusable. To the eye they all present more or less the appearance of soft bituminous coal with a cuboidal fracture. There seems to be no approach in any to the hard, compact, glistening anthracite, with the semiconchoidal fracture. But despite these facts of proximate composition there are several coals of this list which from their mode of burning deserve to be classed as semi-anthracities. These are the coals from the Ouita, the Eureka, and the Shinn openings. The remaining coals are all of the nature of semi-bituminous coals. Even those termed bituminous in the table are so near the border line as not to have the characteristics of that coal at all pronounced; others, from the Coal Hill district—*i. e.*, from the Felker, Allister, and Coal Hill openings—approach nearer to being semi-anthracites.

Arkansas coals are all more or less soft and friable and not well adapted to long transportation. This characteristic is variable in different openings. Much of the coal shipped from Huntington during the past year has been stripped coal, which, being soft and stained, was calculated to injure the reputation of Arkansas coals.

Arkansas coals have all a high evaporating power, burn freely, and make little smoke or soot. For reaching the best results, however, a grate with small openings is necessary, as these coals are liable to decrepitate and to fall through the grate. Coal Hill coal makes an intensely hot fire, producing steam rapidly; but it clinkers and is severe in its action upon grate bars. It slacks a good deal on exposure, and in burning much fine coal is lost through ordinary grate bars. Sebastian county coal is easily ignited and quick burning, but does not produce quite so intense a heat as does the Coal Hill coal; it does not clinker, but leaves a loose ash. The Ouita and Eureka coals are not considered good for steaming purposes. The coking qualities of several of the coals have been tested on a commercial scale and these tests give little prospect that any will produce a merchantable coke. Arkansas coals are all suitable for domestic use, being more or less free burning, easily kindled, and burning with a slight draft. Those of Sebastian county swell and coke somewhat in the fire, but not objectionably so; they leave a loose pulverulent ash and do not burn out the grates. Coal Hill coal is not esteemed as a domestic fuel. In open grates it burns with an objectionably intense heat; with this the sulphur in the coal becomes very active, and, as a result, grates and stoves are corroded. Some cinder or loose clinker is also formed. The Philpott and Felker coals have a much better reputation. The Ouita and Eureka coals are among the best for domestic purposes, and seem to satisfy all the chief requirements. They are especially adapted for use in self-feeding stoves and for kitchen use. They are easily kindled, burn slowly, and do not swell or coke. The Ouita coal leaves a loose reddish ash, but the Eureka coal forms a fusible clinker.

Arkansas coals have heretofore been sent to market without any preparation other than a rough sorting into slack, nut, and lump at the tipple. Operators are now looking toward crushing and screening the coal into various market sizes, and this will, without doubt, add much to the development of the trade.

CALIFORNIA.

Total product in 1889, 121,820 short tons; spot value, $288,232. Total product in 1890, 110,711 short tons; spot value, $283,019.

The total product of coal in California in 1888 was estimated at 95,000 short tons by Mr. William A. Goodyear, who made a special collection of the statistics. This shows an increase during the census year of 26,820 short tons. The returns for 1890 show a decrease from 1889 of 11,109 short tons in product and of $5,213 in value.

The following tables exhibit the production in California in 1889 and 1890 by counties, with the distribution of the product:

Coal product of California in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	
Amador	39, 500	550	850	40, 900	$75, 075
Contra Costa	63, 221	336	1, 388	64, 945	161, 190
Fresno	5, 000	50	5, 050	10, 100	35, 359
Monterey	392	22	258	672	3, 600
San Bernardino	3, 015	2, 188	....	5, 203	13, 008
Total	111, 128	3, 146	7, 546	121, 820	288, 232

Coal product of California in 1890, by districts.

Districts.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Ione (Amador county)	33, 432	50	128	33, 610	$55, 215	291	47
Mount Diablo (Contra Costa, Fresno, and San Bernardino counties)	70, 004	2, 046	4, 926	76, 976	226, 804	303	287
Livermore (Alameda County) (*a*)	....	....	....	....	....	....	....
South Mission (Monterey County) (*b*)	....	25	100	125	1, 000	....	30
Total	103, 436	2, 121	5, 154	110, 711	283, 019	(*c*) 301	364

a Prospecting. *b* Developing. *c* Average for State.

Production in previous years.—Statistics of the coal production of California are available only since 1883. Since that date the annual production has been as follows:

Coal product of California from 1883 to 1890.

Years.	Short tons.	Years.	Short tons.
1883	76, 162	1887	50, 000
1884	77, 485	1888	95, 000
1885	71, 615	1889	121, 820
1886	100, 000	1890	110, 711

COLORADO.

Total product in 1889, 2,597,181 short tons; spot value, $3,993,768. Total product in 1890, 3,094,003 short tons; spot value, $4,344,196.

The total product of Colorado coal in 1889 exceeded the product of 1888 by 411,704 short tons, but the value fell off from $2.20 to $1.54 per short ton, showing a decrease in the total value of $814,281. A further increase of 496,822 short tons is noted in the product of 1890. The total value is increased $350,428, though the average price realized at the mines fell off about 25½ cents per ton.

Coal product of Colorado in 1889 by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Arapahoe	50	737	36		823	$1, 039	2
Boulder	298, 074	11, 325	13, 697		323, 096	494, 569	717
Delta	11	1, 346			1, 357	2, 391	2
Douglas		260			260	520	(a)
El Paso	49, 450	3, 784	978		54, 212	69, 116	124
Fremont	239, 940	4, 508	29, 581		274, 029	581, 125	928
Garfield	200, 607		150	38, 535	239, 292	393, 260	366
Gunnison	177, 303	3, 279	5, 295	66, 565	252, 442	574, 746	489
Huerfano	309, 617	1, 640	22, 460		333, 717	457, 982	657
Jefferson	1, 885	7, 905	1, 000		10, 790	27, 425	16
La Plata	14, 393	7, 596	3	12, 979	34, 971	66, 855	69
Larimer		100			100	150	(a)
Las Animas	756, 064	36, 901	10, 587	189, 982	993, 534	1, 157, 022	1, 354
Mesa		1, 100			1, 100	2, 750	(a)
Montezuma		816			816	2, 155	(a)
Park	37, 873	300	3, 650		41, 823	104, 223	132
Rio Blanco		2, 900			2, 900	5, 700	(a)
Routt		1, 491			1, 491	2, 246	(a)
San Miguel		1, 800			1, 800	7, 200	(a)
Weld	24, 068	3, 460	1, 100		28, 628	43, 294	48
Total	2, 109, 335	91, 248	88, 537	308, 061	2, 597, 181	3, 993, 768	4, 904

[a] The mines in Douglas, Larimer, Mesa, Montezuma, Rio Blanco, Routt and San Miguel counties were not considered commercial mines by the Census Office, and no statistics were obtained as to labor, wages and capital.

Coal product of Colorado in 1890 by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Arapahoe	519	169	12		700	$1, 297	4
Boulder	409, 571	9, 326	6, 807		425, 704	563, 860	979
Delta	550	225			775	1, 125	3
Dolores	800				800	4, 000	6
Douglas		700			700	1, 400	4
El Paso	24, 019	400	1, 198		25, 617	28, 206	54
Fremont	395, 590	1, 738	90		397, 418	610, 570	1, 049
Garfield	163, 884	11, 300	8, 700		183, 884	268, 218	334
Gunnison	153, 875	2, 063	5, 669	67, 605	229, 212	446, 196	389
Huerfano	410, 722	3, 646	13, 464		427, 832	558, 374	907
Jefferson	10, 921	63			10, 984	32, 842	79
La Plata	28, 697	1, 156	30	13, 310	43, 193	119, 005	97
Larimer		1, 500			1, 500	3, 000	2
Las Animas	930, 254	10, 917	7, 231	206, 266	1, 154, 668	1, 335, 366	1, 531
Mesa	950	50			1, 000	2, 000	4
Montezuma	140	98			238	909	8
Park	49, 160	434			49, 594	148, 783	150
Pitkin	14, 912	950	2, 500	56, 000	74, 362	107, 825	96
Rio Blanco		200			200	400	2
Routt	250	455			705	1, 338	7
San Miguel	1, 500				1, 500	3, 000	4
Weld	40, 625	3. 042	2, 750		46, 417	63, 982	118
Small mines		17. 000			17, 000	42, 500	
Total	2, 636, 939	65, 432	48, 451	343, 181	3, 094, 003	4, 344, 196	5, 827

NORTHERN DIVISION.

WELD COUNTY.

Product of coal in Weld county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	20, 450
1887	39, 281
1888	28, 054
1889	28, 628
1890	46, 417

Product of coal in Weld county in 1890, with its value.

	Short tons.	Value.
Sold for railway and commercial use	40, 625	
Sold to local trade and used by employés	3, 042	
Made into coke		
Used at mines for steam and heat	2. 750	
Total	46, 417	$63, 982

The Weld county mines are economically of small importance, only one mine being worked regularly. The coal is the characteristic northern Colorado lignite, and is largely used by the railway.

BOULDER COUNTY.

Product of coal in Boulder county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	220 287
1887	297, 338
1888	315, 155
1889	323, 096
1890	425, 704

Product of coal in Boulder county in 1890, and its value.

	Short tons.	Value.
Sold for railway and commercial use	409, 571	....
Sold for local trade and used by employés	9, 326	....
Made into coke	....	....
Used at mines for steam and heat	6, 807	....
Total	425, 704	$563, 860

Boulder county ranks third in the amount of coal produced in the State, a position it has held for several years. While the field is inferior to that in the southern and western portions of the State, its proximity to Denver and excellent railroad facilities cause a great demand for the coal. There are seven mines in the county, which produced each 30,000 short tons or over in 1890. From the coal of one of these, the Simpson, the following analysis has been made:

Analysis of coal from the Simpson mine, Boulder county, Colorado.

	Per cent.
Water	12.01
Volatile matter	35.19
Fixed carbon	46.24
Ash	6.56
Total	100.00
Sulphur	1.00

JEFFERSON COUNTY.

Product of coal in Jefferson county, Colorado, from 1886 to 1890, inclusive.

Years.	Short tons.
1886	9, 928
1887	12, 000
1888	9, 000
1889	10, 790
1890	10, 984

Coal production of Jefferson county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	10,921	....
Sold to local trade and used by employés	63	....
Made into coke	....	....
Used at mines for steam and heat	....	....
Total production	10,984	$22,842

The only mines operated in Jefferson county are at Golden. The coal vein is vertical and expensive to work, and practically the entire product is used to supply local demand and that of adjacent towns.

The following is an analysis made of Jefferson county coal:

Analysis of Jefferson county coal.

	Per cent.
Water	13.60
Volatile matter	39.90
Fixed carbon	42.43
Ash	4.07
Total	100.00

ARAPAHOE COUNTY.

Product of coal in Arapahoe county, Colorado, from 1886 to 1890, inclusive.

Years.	Short tons.
1886	11,000
1887	16,000
1888	1,700
1889	823
1890	700

Coal production of Arapahoe county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	519	....
Sold to local trade and used by employés	169	....
Made into coke	....	....
Used at mines for steam and heat	12	....
Total production	700	$1,297

No new mine has been opened in Arapahoe county since 1888, and the small production comes from the Scranton mine, operated by the Colorado Eastern Railroad Company.

ROUTT COUNTY.

Product of coal in Routt county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	1,491
1890	705

Coal production of Routt county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	250	
Sold to local trade at mine	455	
Made into coke		
Used by employés and for steam at mine		
Total production	705	$1,338

Coal outcrops over a large portion of Routt county and varies in character from lignite to a hard dry anthracite. The county is without a railway and sparsely settled. Only enough coal is mined to supply fuel for ranchmen and miners. The Yampah Valley Stock Company operates a mine of their own, using the coal chiefly for irrigating pumps.

LARIMER COUNTY.

Product of coal in Larimer county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	100
1890	1,500

Coal production of Larimer county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use		
Sold to local trade	1,500	
Made into coke		
Total production	1,500	$3,000

The coal produced in Larimer county comes from one small mine, the Little Grizzly at Pinkhamton, and is mined only to supply the little local trade. As, however, coal veins outcrop in various portions in the North Park there may be a trifling amount of coal dug at other points by ranchmen for their own use. No record of any such operations has been obtainable.

CENTRAL DIVISION.

DOUGLAS COUNTY.

Product of coal in Douglas county, Colorado, from 1887 to 1890, inclusive.

Years.	Short tons.
1887	3,500
1888	400
1889	260
1890	700

Coal production of Douglas county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use		
Sold to local trade and used by employés	700	
Made into coke		
Used at mines for steam and heat		
Total production	700	$1,400

The Douglas mine was opened in 1886, and a spur track built from the Denver and Rio Grande railroad to the mine from Sedalia; but the operation of the mine was not a financial success, and mining is carried on only upon a very small scale. The coal is used in the immediate neighborhood.

EL PASO COUNTY.

Product of coal in El Paso county, Colorado, from 1886 to 1890, inclusive.

Years.	Short tons.
1886	53,000
1887	47,517
1888	44,114
1889	54,212
1890	25,617

Coal production of El Paso county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	24,019	
Sold to local trade and used by employés	400	
Made into coke		
Used at mines for steam and heat	1,198	
Total production	25,617	$28,206

The coal of El Paso county is a lignite of rather low quality. The properties have been described in Mineral Resources of the United States for 1882, 1883-'84, 1885, and 1886.

PARK COUNTY.

Product of coal in Park county, Colorado, from 1886 to 1890, inclusive.

Years.	Short tons.
1886	23,823
1887	28,421
1888	46,588
1889	41,823
1890	49,594

Coal production of Park county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	49,160	
Sold to local trade and used by employés	434	
Made into coke		
Used at mines for steam and heat	(a)	
Total production	a 49,594	$148,783

a Nut coal and slack coal not included in total, and no account kept.

The only mine producing coal in Park county in 1890 was the Como No. 5, operated by the coal department of the Union Pacific Railway Company. Nos. 1, 2, 3, and 4 are abandoned, and a new opening, Como No. 6, begun late in 1890, was not productive in that year. This opening is made only for economically mining a block of the vein of limited extent.

FREMONT COUNTY.

Product of coal in Fremont county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	332,024
1887	417,326
1888	438,789
1889	274,029
1890	397,418

Coal production of Fremont county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	395,590	
Sold to local trade and used by employés	1,738	
Made into coke		
Used at mines for steam and heat	90	
Total production	397,418	$610,570

Fremont county ranks fourth in the State in importance of coal production. The principal producing properties are owned by the Cañon City Coal and Coking Company and the Colorado Coal and Iron Company. Following are reports of analyses made of coal taken from the Cañon and Chandler mines:

Analyses of coal from Cañon and Chandler mines.

	Cañon mine.	Chandler mine. [a]
	Per cent.	*Per cent.*
Water	3.93	....
Volatile matter	42.43	42.40
Fixed carbon	47.16	53.72
Ash	6.48	3.20
Total	100.00	99.32
Sulphur	....	0.68

[a] Made by Mr. E. E. Burlingame.

SOUTHERN DIVISION.

HUERFANO COUNTY.

Product of coal in Huerfano county, Colorado, from 1886 to 1890, inclusive.

Years.	Short tons.
1886	89,913
1887	131,810
1888	159,610
1889	333,717
1890	427,832

Coal production of Huerfano county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	410,722	....
Sold to local trade and used by employés	3,646	....
Made into coke	....	....
Used at mines for steam and heat	13,464	....
Total production	427,832	$558,374

Huerfano county has been very actively developed since 1888. The completion of the Missouri Pacific and Chicago, Rock Island and Pacific railways to Pueblo and Denver, and the consequent opening of large and prosperous markets in Kansas and Nebraska, together caused the purchase and development of many mines which previously had been undeveloped. The largest new product came from the Colorado Fuel Company, which bought and opened the Rouse mine. The vein worked here is 6 feet in thickness, and the coal is one of the best which reaches the Denver market. It is semi-coking, contains a low percentage of water, and burns freely and with great heat.

At Loma, 3 miles from Walsenburg, the Southern Colorado Coal Company has opened the Loma mines, to be operated in connection with the Chicago, Rock Island and Pacific Railway. The vein worked is 7 feet in thickness, and in quality the coal very closely resembles that from the Rouse mine.

The following analyses have been made of coal from the Lenox, Maitland, and Rouse mines:

Analyses of coals from Huerfano county, Colorado.

	Lenox.	Maitland.	Rouse.
	Per cent.	*Per cent.*	*Per cent.*
Water	2.92	3.10	2.66
Volatile matter	41.18	38.12	36.71
Fixed carbon	45.36	48.58	51.41
Ash	10.54	10.20	9.22
Total	100.00	100.00	100.00
Sulphur	1.39	2.04	1.373

LAS ANIMAS COUNTY.

Product of coal in Las Animas county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	429,706
1887	506,540
1888	706,455
1889	993,534
1890	1,154,668

Coal production of Las Animas county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	930,254	
Sold to local trade and used by employés	10,917	
Made into coke	206,266	
Used at mines for steam and heat	7,231	
Total production	1,154,668	$1,335,366

Las Animas is by far the most important coal producing county in the State, and the increase in the annual production since 1887 has been phenomenal. The product of 1888 was 40 per cent. larger than that of 1887, and that of 1889, 40 per cent. more than that of 1888. The product of 1890 was 20 per cent. greater than that of 1889, and considerably more than twice that of 1887.

The mines of Las Animas county were described in Mineral Resources for 1888. Three of the more important ones are the Chicosa, Sopris, and Victor, of which the following analyses have been made.

Analyses of coals from Las Animas county, Colorado.

	Chicosa. (*a*)	Sopris.	Victor.
	Per cent.	*Per cent.*	*Per cent.*
Water	0.20	0.61	1.26
Volatile matter	28.94	33.18	36.40
Fixed carbon	64.51	57.56	53.10
Ash	6.35	8.65	9.24
Total	100.00	100.00	100.00
Sulphur	0.27	.75	1.11

a Made by Mr. W. Deardon.

LA PLATA COUNTY.

Product of coal in La Plata county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	18,166
1887	22,880
1888	33,625
1889	34,971
1890	43,193

Coal production of La Plata county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	28,697	
Sold to local trade and used by employés	1,156	
Made into coke	13,310	
Used at mine for steam and heat	30	
Total production	43,193	$119,005

The coal mines of La Plata county are operated only for the local demand in Durango and Silverton, both small towns. Some of the coal is burned in locomotives on the Denver and Rio Grande railroad, and most of that from the Porter mine is coked for the use of the San Juan smelter at Durango.

Analyses of La Plata county coals.

	Fairmount vein.	Porter-La Plata vein.	Carbonana.
	Per cent.	*Per cent.*	*Per cent.*
Water	1.25	1.11	1.16
Volatile matter	39.71	36.54	34.33
Fixed carbon	52.90	51.69	52.69
Ash	6.14	10.66	11.82
Total	100.00	100.00	100.00
Sulphur		1.450	1.22

	Porter vein.	Peacock vein.	Graden vein.	San Juan.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	0.63	2.49	2.94	1.12
Volatile matter	34.70	34.31	35.63	37.30
Fixed carbon	57.30	51.98	50.65	54.69
Ash	7.37	11.22	10.78	6.89
Total	100.00	100.00	100.00	100.00
Sulphur	0.737	1.68	1.53	0.864

DOLORES COUNTY.

Product of coal in Dolores county, Colorado, from 1887 to 1890, inclusive.

Years.	Short tons.
1887	1,000
1888	200
1889	....
1890	800

The one mine worked in Dolores county is to supply the Grand View smelter at Rico, 8 miles from the mine. The coke from the coal is said to be of poor quality and very expensive.

WESTERN DIVISION.

PITKIN COUNTY.

Product of coal in Pitkin county, Colorado, from 1887 to 1890.

Years.	Short tons.
1887	4,000
1888	28,113
1889	....
1890	74,362

Coal production of Pitkin county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	14,912	....
Sold to local trade and used by employés	950	....
Made into coke	56,000	....
Used at mines for steam and heat	2,500	....
Total production	74,362	$107,825

The only mine in this county producing in 1890 was the Spring Gulch, operated by the Grand river Coal and Coking Company of Colorado. The coal yields an excellent coke, which gives the greatest satisfaction in blast-furnace use. The coking ovens are located at Cardiff, on the Roaring Fork of Grand river, and about 4 miles south of Glenwood Springs. The coal of this county varies from a high grade anthracite to a dry bituminous, and the completion of the railway being built up Rock creek from Carbondale, and connecting the mines with the Colorado Midland and Denver and Rio Grande railways, will largely increase the output.

GARFIELD COUNTY.

Product of coal in Garfield county, Colorado, from 1887 to 1890, inclusive.

Years.	Short tons.
1887	30,000
1888	115,900
1889	239,292
1890	183,884

Coal production of Garfield county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	163,884	
Sold to local trade and used by employés	11,300	
Made into coke		
Used at mines for steam and heat	8,700	
Total product	(a) 183,884	$268,218

a Slack coal used for steam at three mines not included and no account kept.

The tonnage of coal from Garfield county is yet comparatively small, the distance from the principal markets in Colorado being great and the cost of transportation made high by adverse gradients. The completion of the standard gauge track past the principal mines and to Utah points will probably lead to increased production from these mines to supply Utah trade. None of the coal mined in this county is coked, the greater portion of the output being dry bituminous coal of good quality. The mines and coal of this county have been fully described in past volumes of this series.

GUNNISON COUNTY.

Product of coal in Gunnison county, Colorado, from 1886 to 1890.

Years.	Short tons.
1886	159,951
1887	243,122
1888	258,374
1889	252,442
1890	229,212

Coal production of Gunnison county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	153,875	
Sold to local trade and used by employés	2,063	
Made into coke	67,605	
Used at mines for steam and heat	5,669	
Total production	(a) 229,212	$446,196

a Of this total 52,707 short tons was anthracite coal.

MESA COUNTY.

Product of coal in Mesa county, Colorado, from 1888 to 1890.

Years.	Short tons.
1888	300
1889	1,100
1890	1,000

Coal production of Mesa county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	950	
Sold to local trade and used by employés	50	
Made into coke		
Used at mines for steam and heat		
Total production	1,000	$2,000

SAN MIGUEL COUNTY.

Product of coal in San Miguel county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	1,800
1890	1,500

Coal production of San Miguel county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	1,500	
Sold to local trade and used by employés		
Made into coke		
Used at mines for steam and heat		
Total production	1,500	$3,000

Two small mines supplied fuel to Telluride and vicinity in 1890, but the completion of the Denver and Rio Grande Southern railroad from Dallas to Telluride early in 1891 will probably cause coal mining in this county to cease through the introduction of other coal.

DELTA COUNTY.

Product of coal in Delta county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	1,357
1890	775

Coal production of Delta county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	550	
Sold for local trade and used by employés	225	
Total production	775	$1,125

MONTEZUMA COUNTY.

Product of coal in Montezuma county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	816
1890	238

Coal production of Montezuma county in 1890 and its value.

	Short tons.	Spot value.
Sold for railway and commercial use	140	
Sold to local trade at mine and used by employés	98	
Made into coke		
Used at mines for steam and heat		
Total production	238	$909

In the newly created county of Montezuma the La Plata coal beds outcrop at various points, and near the town of Cortez several small mines have been opened and a little coal produced in 1890 to supply the limited local demand for domestic use. The product is a non-coking bituminous coal, similar to that mined in La Plata county, Colorado.

RIO BLANCO COUNTY.

Product of coal in Rio Blanco county, Colorado, in 1889 and 1890.

Years.	Short tons.
1889	2,990
1890	200

Coal production of Rio Blanco county in 1890, and its value.

	Short tons.	Spot value.
Sold for railway and commercial use		
Sold to local trade and used by employés	200	
Made into coke		
Used at mine for steam and heat		
Total production	200	$400

The coal production of Rio Blanco county is made from a few small mines, and only to supply the local trade at Meeker. The county has not yet been entered by any railway line, and the population is small. The coal field is the extension northward of the important Glenwood field and has been described in previous volumes of the Mineral Resources.

Coal product of Colorado from 1864 to 1890, inclusive.

Years.	Localities.	Product.	
		Short tons.	
1864	Jefferson and Boulder counties		500
1865	do		1,200
1866	do		6,400
1867	do		17,000
1868	do		10,500
1869	do		8,000
1870	do		13,500
1871	do		15,600
1872	do	14,200	
	Weld county	54,340	
			68,540
1873	Jefferson and Boulder counties	14,000	
	Weld county	43,790	
	Las Animas and Fremont counties	12,187	
			69,977
1874	Jefferson and Boulder counties	15,000	
	Weld county	44,280	
	Las Animas and Fremont counties	18,092	
			77,372
1875	Jefferson and Boulder counties	23,700	
	Weld county	59,860	
	Las Animas and Fremont counties	15,278	
			98,838
1876	Jefferson and Boulder counties	28,750	
	Weld county	68,600	
	Las Animas and Fremont counties	20,316	
			117,666
1877			160,000
1878	Northern division	87,825	
	Central division	73,137	
	Southern division	39,668	
			200,630
1879	Northern division	182,630	
	Central division	70,647	
	Southern division	69,455	
			322,732
1880	Northern division	123,518	
	Central division	136,020	
	Southern division	126,403	
	Northwestern division	1,064	
	Unreported mines	50,000	
			437,005
1881	Northern division	156,126	
	Central division	174,882	
	Southern division	269,045	
	Northwestern division	6,691	
	Unreported mines	100,000	
			706,744
1882	Northern division	300,000	
	Central division	243,694	
	Southern division	474,285	
	Northwestern division	43,500	
			1,061,479
1883	Northern division	213,903	
	Central division	396,401	
	Southern division	501,307	
	Northwestern division	87,982	
			1,229,593
1884	Northern division	253,282	
	Central division	296,188	
	Southern division	483,865	
	Northwestern division	96,689	
			1,130,024
1885	Northern division	242,846	
	Central division	416,373	
	Southern division	571,684	
	Southwestern division	125,159	
			1,356,062
1886	Northern division	260,145	
	Central division	408,857	
	Southern division	537,785	
	Southwestern division	161,551	
			1,368,338

Coal product of Colorado from 1864 to 1890, inclusive—Continued.

Years.	Localities.	Product.	
		Short tons.	
1887.....	Northern division	364,619	
	Central division	491,764	
	Southern division	662,230	
	Western division	273,122	1,791,735
1888.....	Northern division	353,909	
	Central division	529,891	
	Southern division	899,690	
	Western division	401,987	2,185,477
1889.....	Northern division	364,928	
	Central division	370,324	
	Southern division	1,362,222	
	Western division	499,707	2,597,181
1890.....	Northern division	486,010	
	Central division	473,329	
	Southern division	1,626,493	
	Western division	491,171	3,077,003

GEORGIA.

Total product in 1889, 225,934 short tons; spot value, $338,901. Total product in 1890, 228,337 short tons; spot value, $238,315.

The coal-producing district of Georgia lies in the extreme northwestern portion of the State and along the eastern border of the Appalachian coal field. The production up to the close of 1890 has been limited to Dade county, but during that year active development work was carried on in Walker county, and the company controlling the property reports that it expects to be in operation in 1891.

The Dade county mines operate very steadily, reporting for 1890, three hundred and thirteen days mining, and employing 425 men. The following tables show the production of Georgia for 1889 and 1890 with the value and distribution of the product.

Coal product of Georgia in 1889 and 1890 by counties.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
1889......	46,131	158	15,000	164,645	225,934	$338,901	....	....
1890......	57,949	....	....	170,388	228,337	238,315	313	425

Coal product of Georgia from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	150,000	1888	180,000
1885	150,000	1889	225,934
1886	223,000	1890	228,337
1887	313,715		

IDAHO.

In the 1888 volume of Mineral Resources, Idaho is credited with a coal product of 400 short tons, valued at $1,800. The census investigation of 1889, however, failed to discover any producing mines in that year, and no product has been reported in 1890. There have been some coal discoveries in the State, but Mr. F. F. Chisolm, who has visited the localities to investigate the subject, reports the coal of so poor a quality that it will not bear competition with other coals brought into the State, nor with the wood which is plentiful in the same localities.

ILLINOIS.[a]

Total product in 1889, 12,104,272 short tons; spot value, $11,755,203.
Total product in 1890, 15,292,420 short tons; spot value, $14,171,230.

According to the census report on the production of coal in Illinois for 1889, the number of tons produced was 12,104,272. Col. Lord, for the same period, gives the product as 11,597,963 short tons. The difference is but little more than 4 per cent., and serves to show the value and practically correct work of the state bureau of statistics. In the accompanying tables of production the figures for 1889 are taken from the published reports of the Census Office, while those for other years and in the comparative tables in which the product for 1889 is contained, Col. Lord's figures are adhered to. The following table shows the product for 1889, with the distribution and value:

Coal product of Illinois for 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.		
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Adams	....	294	....	....	....	294	$730
Bond	50,510	9,000	413	3,000	....	62,923	58,783
Brown	....	60	....	....	....	60	90
Bureau	270,535	44,103	790	27,145	....	342,573	441,360
Calhoun	....	967	14	....	....	981	1,226
Cass	83	3,114	40	186	....	3,373	5,702
Christian	109,361	19,452	1,159	6,686	....	136,658	106,745
Clinton	136,417	6,850	1,062	11,711	....	156,040	128,957
Crawford	....	100	10	....	....	110	220
Effingham	....	770	5	....	....	775	1,170
Franklin	....	700	....	....	....	700	1,050
Fulton	382,618	67,743	4,070	11,952	....	466,383	503,912
Gallatin	40,008	2,455	232	448	11,200	54,343	38,732
Greene	1,880	12,912	169	8	....	14,969	24,436
Grundy	524,412	23,083	6,148	952	....	554,595	778,752

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[a] Statistics for 1890, compiled from the annual report of Col. J. S. Lord, secretary of the bureau of labor statistics of the State of Illinois.

Coal product of Illinois for 1889, by counties—Continued.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.		
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Hamilton		450				450	$875
Hancock		5,170	79			5,249	8,025
Hardin		40				40	50
Henry	70,383	37,727	1,276	3,156		112,542	159,978
Jackson	453,176	37,496	5,939	17,023		513,634	474,933
Jasper		100				100	200
Jefferson		1,775	55	120		1,950	2,925
Jersey		1,086	17	1		1,104	1,669
Johnson	3,000	410	100			3,510	3,020
Kankakee	51,331	2,285	900	770		55,286	78,588
Knox		46,150	629	20		46,799	58,546
La Salle	749,782	176,603	15,563	30,184	1,700	973,832	1,118,631
Livingston	276,557	49,029	3,511	8,992		338,089	376,747
Logan	105,688	35,317	9,337	4,260		154,602	174,531
McDonough	66,660	26,603	1,197	1,876		96,336	154,549
McLean	117,897	40,157	3,530	7,550		169,134	216,535
Macon	103,420	92,365	390	375		196,550	229,131
Macoupin	1,237,656	51,164	6,072	44,220		1,339,112	973,487
Madison	468,689	75,900	3,924	28,483		576,996	438,361
Marion	198,582	10,995	2,967	8,275		220,819	176,982
Marshall	35,855	10,130	977	4,800		51,762	63,890
Menard	202,603	42,873	1,024	8,550		255,050	238,861
Mercer	232,969	19,955	2,861	6,388		262,173	295,132
Montgomery	19,078	12,930	40	1,200		33,248	33,479
Morgan		19,805	323	428		20,556	30,963
Peoria	446,371	128,709	4,482	9,238		588,800	597,449
Perry	436,288	22,983	6,144	27,140		492,555	400,126
Pike		85	17			102	198
Randolph	93,022	16,409	612	1,322		111,365	86,446
Richland		113	27			140	280
Rock Island	13,324	43,922	601	1,280		59,127	79,023
St. Clair	1,099,564	125,269	1,904	42,629		1,269,366	840,393
Saline	29,032	6,505	708	850		37,095	32,724
Sangamon	722,234	134,112	9,289	29,068		894,703	783,279
Schuyler	19,656	4,280	59	5,699		29,694	25,963
Scott	13,000	3,090	547	102		16,739	25,203
Shelby		11,703	47			11,750	20,155
Stark	200	21,203	159	6		21,568	31,310
Tazewell	50,906	14,806	582	1,725		68,019	74,173
Vermilion	494,915	88,917	2,185	7,191		593,208	606,598
Warren		15,992	101	11		16,104	30,378
Washington	26,183	7,031	136	1,567		34,917	32,538
Will	276,568	5,960	5,590	13,520		301,638	353,483
Williamson	175,139	12,253	1,087	4,680		193,159	128,797
Woodford	79,381	48,018	2,124	11,000		140,523	194,934
Total	9,884,883	1,699,478	111,224	395,787	12,900	12,104,272	11,755,203

The product of lump coal in Illinois in 1890 was 12,638,364 short tons, valued at $12,882,936. Col. Lord estimates that in order to obtain the entire product of all grades of coal—which shall include nut, pea, and slack—the above tonnage should be increased about 21 per cent and the value about 10 per cent. Following this suggestion the total product of all grades for 1890 (corresponding with the statistics for 1889) is found to be 15,292,420 short tons valued at $14,171,230.

The foregoing figures exhibit an increase in the product of 1890 over

1889 of 3,188,148 short tons, and in value of $2,416,027. According to Colonel Lord's statements the value of lump coal per ton at the mines decreased from $1.08 in 1889 to $1.02 in 1890. The average value of the total product of all grades decreased from 97 cents per ton in 1889 to 93 cents per ton in 1890.

The number of employés reported by the census office in 1889 was 23,934; Colonel Lord's report for the year gives 30,076. This variance is readily accounted for by a corresponding difference in the number of days worked. The average number of days actually made by the 23,934 men reported by the census office was 214. Colonel Lord reports the average number of days the *collieries were active* as 211.5. The miners however will work only about four days in five, which would reduce this average to about 175 days per man, or an equivalent average, number of men considered, to that given by the Census Office.

Number and classification of mines.—The number of mines in Illinois reported by the census for 1889 was 1,072, of which 358 are given as commercial operations and 714 as local banks. The State report gives an aggregate of 854 openings in 1889, and 936 in 1890. Analyzing the character of these on the basis of their output for 1890 and by districts, the following results are obtained:

Classification of Illinois coal mines by output and districts.

Districts.	Number of mines producing—				Total number of mines of all kinds.
	Less than 1,000 tons.	From 1,000 to 10,000 tons.	From 10,000 to 50,000 tons.	Over 50,000 tons.	
First	18	20	22	19	79
Second	149	86	14	5	254
Third	115	108	37	13	273
Fourth	48	36	27	26	137
Fifth	68	51	55	19	193
Total	398	301	155	82	936

This illustrates the relative importance of the mines in the several districts as they have been found and reported for the past year. An opportunity to compare this with classifications of a similar kind made for a series of years, is presented in the following table:

Classification of Illinois coal mines by annual output for eight years.

Years.	Number of mines producing—				Total number of mines.
	Less than 1,000 tons.	From 1,000 to 10,000 tons.	From 10,000 to 50,000 tons.	Over 50,000 tons.	
1883	209	233	135	62	639
1884	262	273	146	60	741
1885	286	290	139	63	778
1886	316	280	136	57	789
1887	320	278	139	64	801
1888	327	271	152	72	822
1889	321	316	139	78	854
1890	398	301	155	82	936

The principal increase in the number of openings reported for 1890 is shown to have been in the least important class, though in the two higher classes there is a notable increase in the number of mines. The identity of these new mines, the place, character, and output of each may be established by reference to the subsequent county tables. The relative product of these groups of mines in short tons and for the past four years, as shown in the following table, will still further illustrate their relative importance:

Relative production by the several classes of mines for four years.

Years.	Mines producing more than 50,000 tons.		Mines producing from 10,000 to 50,000 tons.		Mines producing less than 10,000 tons.		Total.	
	Number.	Short tons.	Number.	Short tons.	Number.	Short tons.	Number.	Short tons.
1887	64	5,949,894	139	3,270,681	598	1,058,315	801	10,278,890
1888	72	7,188,507	152	3,666,324	598	1,000,357	822	11,855,188
1889	78	7,235,577	139	3,210,920	637	1,151,466	854	11,597,963
1890	82	8,011,787	155	3,488,601	699	1,137,976	936	12,638,364

The output for 1890.—Notwithstanding the strike which prevailed in the first and second districts during the earlier months of the year the aggregate product of the State has been considerably larger than ever before. The total for 1890 is 12,638,364 short tons of lump coal as against 11,597,963 short tons the preceding year. The absolute gain has been 1,040,401 short tons of lump coal, or 9 per cent. of the output of 1889. The following groups of totals show in what districts the gains and losses have been made:

Comparative coal product in Illinois in 1889 and 1890, by districts.

Districts.	1889.	1890.	Gain.	Loss.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
First	2,530,453	2,303,326		227,127
Second	1,087,848	1,002,600		85,248
Third	2,050,349	2,375,970	325,621	
Fourth	3,164,835	3,716,464	551,629	
Fifth	2,764,478	3,240,004	475,526	
The State	11,597,963	12,638,364	1,352,776	312,375

From this it appears that the gain in the central and southern field has been greatly in excess of the losses sustained in the northern field by reason of the strike. This does not cover the whole case, however, as the same suspension also influenced the product of 1889. There was no work done in the disaffected districts during May or June of that year and but little for several months before; meanwhile there was no intermission of operations in other parts of the State. Thus the fiscal year of 1889 also showed a falling off in the tonnage of the northern field and an increase in that of the central and southern. The gains in one quarter, however, were not enough in that year to make up for the losses in the other, and the net decline in product for the State was 257,225 tons. Taking the results of the two years in combination there was a falling off of product in the northern field of 694,452 tons in 1889 and of 312,375 tons in 1890, or 1,006,827 tons in all, while in the central and southern districts there was an increase of 437,227 tons in 1889 and of 1,352,776 tons in 1890, or of 1,790,003 tons in all. The difference between these totals, 783,176 tons, represents the net increase in the tonnage of the State during the last two years, or since 1888, notwithstanding the serious interruption of business and consequent impairment of output which resulted from the six months of controversy about wages. These facts afford rather strong evidence of the material progress of the industry and incidently point to a possible though gradual shifting of the center of greatest activity from the northern to the central coal field.

Total product of lump coal in Illinois for ten years.

Years.	Short tons.	Years.	Short tons.
1880	6, 115, 377	1886	9, 246, 435
1882	9, 115, 653	1887	10, 278, 890
1883	10, 030, 991	1888	11, 855, 188
1884	10, 101, 005	1889	11, 597, 963
1885	9, 791, 874	1890	12, 638, 364

For the year 1882 and for each subsequent year these statistics have been compiled by the Illinois State bureau; the figures given above for 1880 are those published by the Tenth United States Census. The results for 1881 are omitted from this table for the reason that no State report on this subject was made prior to 1882.

The conspicuous feature of this showing is the fact that the output of coal in this State has more than doubled during ten years. It is observable, however, that the increase has not been uniform from year to year, but that from 1883 to 1887 there was a decline in tonnage, followed by material gains in more recent years.

Although the mining of coal has been carried on to greater or less extent in fifty-seven counties in the State during the last year, the greater portion of the total product has been derived from comparatively few of them. The relative rank of the ten counties from which the greatest quantities have been mined is indicated as follows:

Product of coal in the ten principal counties of Illinois in 1890.

Rank.	Counties.	Short tons.	Rank.	Counties.	Short tons.
1	Macoupin	1, 369, 919	6	Grundy	654, 017
2	St. Clair	1, 332, 978	7	Madison	646, 228
3	La Salle	926, 214	8	Jackson	580, 521
4	Sangamon	879, 888	9	Perry	497, 768
5	Vermilion	704, 509	10	Peoria	482, 725

The amount of coal derived from these ten counties was 8,074,467 short tons, or about two-thirds of all the coal produced in the State.

Following is a statement of the output of each county for a series of four years, with the gain and loss in each county during 1890:

Comparative coal product of Illinois in 1887, 1888, 1889, and 1890.

Districts.	Output.				1890 compared with 1889.	
	1887.	1888.	1889.	1890.	Gain.	Loss.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
First district	2, 686, 829	2, 877, 794	2, 530, 453	2, 303, 326	....	227, 127
Counties:						
Grundy	792, 954	862, 866	698, 033	654. 017	....	44, 016
Kankakee	97, 000	82, 000	67, 380	62, 460	....	4, 920
La Salle	1, 125, 235	1, 090, 435	1, 039, 703	926, 214	....	113, 489
Livingston	387, 600	495, 388	382, 965	372, 504	....	10, 461
Will	284, 040	347, 105	342, 372	288, 131	....	54, 241
Second district	1, 069, 027	1, 293, 187	1, 087, 848	1, 002, 600	71, 059	156, 307
Counties:						
Bureau	429, 580	635, 097	493, 730	372, 701	....	121, 029
Hancock	6, 208	6, 515	6, 028	6, 948	920	....
Henry	117, 533	108, 831	101, 716	98, 734	....	2, 982
Knox	64, 324	57, 043	57, 588	51, 653	....	5, 935
Marshall	73, 928	87, 013	59, 784	56, 574	....	3, 210
McDonough	110, 103	104, 274	98, 386	83, 401	....	14, 985
Mercer	127, 708	167, 931	175, 690	238, 290	62, 600	....
Rock Island	85, 282	57, 872	47, 363	39, 696	....	7, 667
Schuyler	22, 686	34, 403	16, 243	21, 836	5, 593	....
Stark	17, 865	18, 690	19, 171	18, 672	....	499
Warren	13, 810	15, 518	12, 149	14, 095	1, 946	....
Third district	1, 781, 395	2, 192, 121	2, 050, 349	2, 375, 970	365, 497	39, 876
Counties:						
Cass	2, 325	7, 300	4, 414	4, 650	236	....
Fulton	337, 215	461, 589	366, 577	404, 417	37, 840	....
Logan	159, 000	174, 330	138, 700	164, 650	25, 950	....
McLean	141, 700	117, 110	129, 322	173, 492	44, 170	....
Menard	155, 621	181, 075	181, 621	230, 662	49, 041	....
Peoria	452, 123	533, 817	454, 731	482, 725	27, 994	....
Tazewell	51, 847	59, 324	67, 973	81, 141	13, 168	....
Vermilion	359, 119	499, 076	537, 411	704, 509	167, 098	....
Woodford	122, 445	158, 500	169, 600	129, 724	....	39, 876
Fourth district	2, 568, 291	2, 854, 540	3, 164, 835	3, 716, 464	613, 222	61, 593
Counties:						
Bond	36, 076	38, 200	59, 724	66, 746	7, 022	....
Calhoun	....	1, 036	1. 078	1, 468	390	....
Christian	149, 973	147, 030	249, 774	439, 451	189, 677	....
Coles	34, 612	27, 210	....	....	....	....
Effingham	....	....	....	796	796	....
Greene	12, 578	14, 494	19, 048	11, 714	....	7, 334
Jasper	....	....	....	152	152	....
Jersey	2, 684	3, 949	4. 040	7. 500	3, 460	....
Macon	118, 183	280, 805	233, 309	179, 050	....	54, 259
Macoupin	926, 588	1, 016, 624	1, 202, 187	1, 369, 919	167, 732	....
Madison	521, 705	512, 948	490, 181	646, 228	156, 047	....
Montgomery	10, 220	14, 295	24. 425	58, 617	34, 192	....
Morgan	6, 609	12, 545	13, 019	16, 601	3, 582	....
Pike	....	....	....	135	135	....
Richland	....	....	....	154	154	....
Sangamon	730, 391	764, 970	846, 012	879, 888	33, 876	....
Scott	9, 802	12, 491	15, 028	20, 022	4, 994	....
Shelby	8, 810	7, 943	7, 010	18, 023	11, 013	....
Fifth district	2, 173, 348	2, 637, 546	2, 764, 478	3, 240, 004	522, 512	46, 986
Counties:						
Clinton	55, 238	66, 463	121, 557	170, 416	48, 859	....
Franklin	....	....	....	700	700	....
Gallatin	31, 437	45, 374	30, 044	52, 383	22, 339	....
Hardin	....	....	....	40	40	....
Hamilton	....	....	....	450	450	....
Johnson	28, 000	28, 210	3, 000	12, 110	9, 110	....
Jackson	375, 718	445, 575	477, 474	580, 521	103, 047	....

Comparative coal product of Illinois in 1887, 1888, 1889, and 1890—Continued.

Districts.	Output.				1890 compared with 1889.	
	1887.	1888.	1889.	1890.	Gain.	Loss.
Counties—Continued:	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Jefferson	....	....	....	2, 100	2, 100	....
Marion	98, 915	156, 975	180, 777	218, 499	37, 722	....
Perry	319, 552	306, 235	381, 347	497, 768	116, 421	....
Randolph	74. 263	167, 321	98, 202	134, 699	36, 497	....
Saline	19, 518	32, 550	35, 496	45, 845	10, 349	....
St. Clair	1, 018, 149	1, 184, 579	1, 198, 100	1, 332, 978	134, 878	....
Washington	40, 220	43, 600	36, 220	25, 160	....	11, 060
Williamson	112, 338	160, 664	202, 261	166, 335	....	35, 926
State totals	10, 278, 890	11, 855, 188	11, 597, 963	12, 638, 364	(*a*)1, 040, 401	....

a Net increase.

Number of employés.—Contrary to all precedent the number of miners and others employed at coal mines, as reported for 1890, according to Colonel Lord's report, has not increased with the larger output of coal, but has materially fallen short of the number reported by him for 1889, but it does show an increase of 4,640 over the number of employés reported by the Census Office for 1889. The following figures show the number of employés reported by Colonel Lord for each of ten years:

Employés in Illinois coal mines for ten years.

Years.	Miners.	Others.	Total.
1880	....	....	16, 801
1882	....	....	20, 290
1883	20, 839	3, 100	23, 939
1884	20, 610	4, 965	25, 575
1885	20, 772	5, 174	25, 946
1886	20, 973	4, 873	25, 846
1887	21, 158	5, 646	26, 804
1888	23, 649	5, 762	29, 410
1889	23, 583	6, 493	30, 076
1890	20, 106	8, 468	28, 574

These totals are not the result of an enumeration of the employés at the several mines at any particular time, but are made up from the numbers reported to the inspector by each proprietor as the average number employed during the winter months. This is readily obtained from monthly pay rolls, and though the result is necessarily somewhat less than exact as to individuals, there is no reason to doubt the substantial correctness of the numbers thus reported.

It will be observed, however, that heretofore there has been a uniform increase in the number of employés corresponding in general with the increase in product; whereas for 1890, with an increase of 9 per cent. in tonnage, there is a decrease of 5 per cent. in the number of men employed. An examination of the returns by districts shows that this falling off is chiefly in the first and second districts, where the recent long strike prevailed, and from which there was a general exodus of miners at that time. In the third and fourth districts the working force has remained about stationary, though the output has been larger than ever, while in the fifth district there has been an increase in product and a decrease of 7 per cent. in the number of men.

Days of active operations.—There has necessarily been some impairment of the time actually devoted to the product of 1890, owing to the entire suspension of operations for a portion of the year in one important field. The experience of the mines in the various districts for the present and two preceding years is given below.

Number of operating days in Illinois coal mines for 1888, 1889, and 1890.

Districts.	1888.	1889.	1890.
First	216	188	178
Second	219	198	182
Third	219	203	193
Fourth	230	240.3	243
Fifth	219	235	232
The State	220.6	211.5	203.5

The mines which are enumerated in this classification are those which are supposed to have operated continuously throughout the year, so far as the demand for coal justified it, and do not embrace those which are worked through the winter months only. The average running time of all mines is found to have been 203.5 days in 1890, as against 211.5 days in 1889, and 220.6 days in 1888. The falling off is observed to have taken place in the first three districts, while the average for the others has increased.

Average value of coal at the mines.—The customary computation of average worth of coal at the mine, based upon the figures given to the inspectors by the proprietors of mines, has been made for 1889 and 1890, and the results are presented herewith in comparison with similar results for a series of years:

Average value of Illinois coal per ton at the mines during eight years.

Districts.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
First	1.75	1.59	1.49	1.41	1.32	1.32	1.37	1.36	1.30
Second	1.87	1.97	1.79	1.71	1.57	1.50	1.47	1.43	1.48
Third	1.43	1.45	1.31	1.25	1.16	1.10	1,14	1.10	1.06
Fourth	1.33	1.32	1.09	.965	.97	.89	.95	.97	.87
Fifth	1.31	1.26	.96	.894	.86	.82	.86	.88	.81
The State	1.51	1.48	1.26	1.17	1.10	1.09	1.12	1.08	1.02

The fluctuations in the average value of coal are here shown for a series of years and for each district and the State. The averages as computed for the State present a uniform decline from year to year, save a slight exception in 1888, and the total falling off in value since 1882 is 50 cents a ton, or 33⅓ per cent. One-half of this depreciation, however, occurred in the first three years, and one-half of the remainder in the two years following. The further decline from $1.10 to $1.02 has been more gradual and the result of four years depression of prices. Referring to the experience of the various districts it is noticeable that the average for the State has been depressed during the past year, almost wholly by the decline in prices in the fourth and fifth districts, in the former of which the average value has fallen off 9.2 cents, and the latter 5.6 cents a ton.

Prices paid for mining by hand.—An examination of the following table shows the movement in the rate of wages which has characterized coal mining in this State during a series of eight years:

Average prices paid per ton for hand-mining, from 1883 to 1890.

Districts.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
First	$0.917	$0.906	$0.867	$0.859	$0.891	$0.889	$0.892	$0.812
Second	.983	1.00	.941	.927	.927	.918	.924	.892
Third	.875	.873	.814	.729	.688	.706	.699	.680
Fourth	.71	.694	.62	.573	.576	.614	.599	.584
Fifth	.619	.60	.511	.501	.537	.554	.525	.511
The State	0.802	0.783	0.725	0.676	0.727	0.717	0.731	0.683

The foregoing averages have been computed every year for eight years by the proper combination of the number of tons mined at each specific rate, with the various rates paid and with due allowance for the difference, where any is found, between the rates paid in summer and in winter. They are, therefore, mathematically true as averages though not identical with the price paid at any particular place. The object of the table like that concerning the average value of product is to present an illustration of the tendency, both of values and wages, in specific terms, from year to year, for the various mining districts and the State as a whole.

The decline in the average rate of wages in this State during eight years is represented by the difference between 80.2 cents and 68.3 cents per ton, or 11.9 cents, or 14.8 per cent. It is observed, however, that during the years from 1885 to 1889, the variation from year to year was inconsiderable and without definite tendency, but that from 1883 to 1885 there was a drop of about 7 cents a ton, and during the last year an average decline of 5 cents. The latter is clearly due to the reduction of 7½ cents a ton, which was imposed in certain districts as a result of the strike of the past year. The average for the year following, or the current year (1891), during which the old rate of wages in the same field has been restored, should consequently be higher. The specific fluctuations in the various districts during the past year and seven preceding years may be observed in the table. The average decline in the first district is 7.96 cents, and in the second, only a part of which was affected by the strike, 3.24 cents, while in each of the other districts the variation is very small, though uniformly a decline.

Mining with machines.—The amount of coal undercut with machines during the year has been somewhat larger than in any previous year, and the number of machines in use has been greater than in the preceding year, though less than in the year 1888. The number of mines in which this method has been practiced has not increased, though the machines have been abandoned in some mines and introduced in others. The statistics for the last three years are as follows:

Statistics of machine mining in Illinois for three years.

Years.	Number of mines.	Number of machines.	Number of tons cut.	Per cent. of total product.	Number of men employed.	Per cent. of total men.
1888	39	272	2,243,810	18.9	3,088	10.5
1889	35	235	2,346,713	20.2	3,439	11.4
1890	34	266	2,881,983	22.8	3,141	10.9

The mines reported here are all those in which machines have been used at all, and is not confined to those in which they are used exclusively. The inference from these figures is that while the use of machines has not become more general, the number has been increased in mines where they have given satisfactory results.

The fields in which the machine process is most general are indicated by the following statement of the number of tons mined by this method in each of the several districts in 1890. With these figures are combined the number and the names of the machines used:

Product by machine mining and number and names of machines used.

Districts.	Total tons produced.	Number and kinds of machines used.								Number of men employed.
		Harrison.	Chouteau.	Ingersoll.	Kangley.	Legg.	Sperry.	Yock.	Total machines.	
First	89,414	14			5	4	4		27	224
Second	20,000	12							12	80
Third	55,854	6							6	50
Fourth	1,615,453	128	17	4		3			152	1,614
Fifth	1,101,262	54	9					6	69	1,173
Total	2,881,983	214	26	4	5	7	4	6	266	3,141

As compared with the preceding year, these figures show an increase of machine product of 241,580 tons in the fourth district and of 295,459 tons in the fifth district, with but slight changes in the others. Several new machines have made their appearance during the year, known severally as the Ingersoll, Kangley, and Sperry, and the number of Chouteau machines, which have recently been introduced, has increased from 14 to 26.

The rates of wages paid to men employed in operating machines have not materially changed during the last three years, as appears in the following group of average daily wages:

Wages paid machine operators for three years in Illinois.

Occupation.	1888.	1889.	1890.
Cutters	$2.83	$2.34	$2.29
Helpers	1.70	1.78	1.77
Blasters	2.07	2.09	2.07
Loaders	1.79	1.80	1.78
Timberers	2.02	2.07	2.04
Laborers	1.61	1.66	1.73
Drillers	2.00	2.00	....

Casualties in 1890.—The number of accidents, fatal and otherwise, which have befallen employés about mines during 1890 was somewhat greater than in the year preceding. The increase in killed was 11, or from 42 to 53, and the increase in injured 93, or from 201 to 294. The statistics of the killed and hurt in the mines of the State for eight years are as follows:

Casualties in Illinois coal mines compared with annual production for eight years.

Years.	Number killed.	Number injured.	Total number of men employed.	Total number of tons of coal produced.	Total casualties.		Non-fatal casualties.	
					Number of employés to each life lost.	Number of tons of coal produced to each life lost.	Number of employés to each accident.	Number of tons of coal produced to each accident.
1883	184	231	23,939	10,030,991	179.6	74,858	103.6	43,424
1884	46	197	25,575	10,101.005	556	219,587	125.8	51,274
1885	39	176	25,446	9,791,874	652.4	251,074	144.6	55,634
1886	52	169	25,846	9,246,435	497	177,816	153.5	54,713
1887	41	180	26,804	10.278,890	654	244,735	149	57,105
1888	55	179	29,410	11,855,188	534.7	215,549	164.3	66,241
1889	42	201	30,076	11,597,963	716.1	276,142	149.6	57,701
1890	53	294	28,574	12,638,364	539.1	238,459	97.2	42,987
Totals	462	1,627	215,670	85,540,710	....	....	....	....
Averages	57.7	203.3	26,958	10,692,589	466.8	185,153	132.5	52,575

INDIANA.

Total product in 1889, 2,845,057 short tons; spot value, $2,887,852.
Total product in 1890, 3,305,737 short tons; spot value, $3,259,233.

The coal product of Indiana in 1888 was 76,732 short tons less than 1887. This decrease was attributed principally to the increasing consumption of natural gas in Indianapolis and other cities of the State and to the consumption of oil as a fuel in Chicago. In Mineral Resources of 1888 it was stated that if the use of natural gas throughout the State, and of oil in Chicago materially increased, the production of Indiana coal would proportionately decrease. The prophecy seems to have been fulfilled, for in 1889 the production of Indiana coal decreased 295,922 tons from that of 1888, with a much greater difference in the value, namely, $1,509,518. In other words, the average price per ton fell from $1.40 in 1888 to $1.02 in 1889. Whether this great difference is altogether due to the above-mentioned causes may be doubted. It is probable that the market was considerably affected by the weather. Bituminous coal is the principal fuel in the State, and like the anthracite coal in the East, depends greatly on the ruling temperature.

In 1890 the coal operators of the State made a determined effort to restore production of Indiana coal to its former importance. This could only be accomplished by a reduction of wages and prices. The necessary reduction was made and the average price realized for coal during the year was less than $1 per ton. The result, however, was satisfactory so far as increased output was concerned, for the product for the year was over 450,000 tons greater than the previous one and 88,826 tons more than in 1887, before the demoralizing effect of gas and oil had been felt.

The following tables exhibit the amount and value of the coal produced in Indiana in 1889 and 1890, by counties, with the distribution of the product:

Coal product of Indiana in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Clay	647, 442	31, 650	16, 557	....	695, 649	$795, 140	2, 592
Daviess	176, 244	12, 419	2, 922	....	191, 585	195, 793	455
Dubois	5, 917	9, 531	400	....	15, 848	18, 500	41
Fountain	38, 485	2, 291	365	....	41, 141	53, 218	85
Gibson	128	1, 099	40	....	1, 267	1, 941	7
Greene	175, 753	3, 231	6, 865	....	185. 849	169, 595	296
Knox	7, 200	1, 840	....	....	9, 040	10, 405	22
Martin	....	710	....	....	710	887	....
Owen	225	3, 703	30	....	3, 958	4. 292	17
Parke	344, 658	6, 400	6, 376	....	357, 434	377, 324	591
Perry	27, 186	12, 284	580	....	40, 050	47, 175	109
Pike	138, 380	8, 487	2, 857	4, 800	154. 524	128, 867	340
Spencer	14, 934	3, 122	400	....	18. 456	21, 207	29
Sullivan	271, 977	21, 912	15, 363	8, 000	317, 252	299, 286	556
Vanderburg	89, 820	87, 594	6, 528	....	183. 942	212, 572	318
Vermillion	178, 925	6, 426	2, 300	....	187, 651	167, 590	276
Vigo	353, 685	13, 318	4, 900	....	371, 903	330, 205	629
Warren	....	2, 160	....	....	2, 160	3, 555	....
Warrick	56, 153	9, 758	727	....	66, 638	50, 300	85
Total	2, 527, 112	237, 935	67, 210	12, 800	2, 845, 057	2, 887, 852	6, 448

Coal product of Indiana in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Clay	1,129,638	25,911	6,181	....	1,161,730	$1,177,666	218	2,179
Daviess	188,604	1,092	....	....	189,696	197,696	231	280
Dubois	13,494	300	200	....	13,994	16,056	216	40
Fountain	23,300	100	600	....	24,000	24,000	260	48
Gibson (*a*)	....	....	....	....	....	....	....	....
Greene	174,988	22,000	350	....	197,338	186,294	218	250
Knox (*a*)	....	....	....	....	....	....	....	....
Owen (*a*)	....	....	....	....	....	....	....	....
Perry	33,501	6,100	600	....	40,201	42,201	250	100
Parke	343,960	1,500	....	....	345,460	378,033	254	558
Pike	109,706	400	3,600	2,130	115,836	113,000	170	235
Spencer	11,256	50	350	....	11,656	11,116	261	39
Sullivan	255,466	11,983	11,874	7,000	286,323	268,525	181	588
Vigo	423,460	4,488	1,212	....	429,160	341,998	262	454
Vanderburgh	77,633	106,071	8.580	....	192,284	197,224	244	307
Vermillion	171,500	1,000	500	....	173,000	203,000	161	280
Warrick	80,231	8,172	656	....	89,059	66,424	222	131
Small mines	....	36,000	....	....	36,000	36,000	....	....
Total	3,036,737	225,167	34,703	9,130	3,305,737	3,259,233	(*b*) 220	5,489

a The entire product of Gibson, Knox, and Owen counties is from country banks and is included in the total estimated product of small mines.

b Average for the State.

Product of coal in Indiana from 1873 to 1890.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	1,000,000	1879	1,196,490	1885	2,375,000
1874	812,000	1880	1,500,000	1886	3,000,000
1875	800,000	1881	1,771,536	1887	3,217,711
1876	950,000	1882	1,976,470	1888	3,140,979
1877	1,000,000	1883	2,560,000	1889	2,845,057
1878	1,000,000	1884	2,260,000	1890	3,305,737

INDIAN TERRITORY.

Total product in 1889, 752,832 short tons; spot value, $1,323,807. Total product in 1890, 869,229 short tons; spot value, $1,579,188.

All of the producing mines in the Indian Territory are in the Choctaw Nation Reservation. Until 1889 the Missouri, Kansas and Texas railroad was the only means of reaching a market, and all the mines were along the line of the road or reached by spurs built from it. In 1889, however, the Choctaw Coal and Railway Company, building through the Territory, secured valuable rights from the Indians for mining coal, and have made considerable progress in the development of mines at Hartshorne, about 18 miles from where the Choctaw Railroad crosses the Missouri, Kansas and Texas, at South McAlester. The following description of the Choctaw coal fields, by Mr. H. M. Chance, was read before the February (1890) meeting of the American Institute of Mining Engineers in Washington:

Geology of the Choctaw coal field.—"The Choctaw coal field is a direct westward extension of the Arkansas coal field, but its coals are not like Arkansas coals, except in the country immediately adjoining the Arkansas line.

"From the base of the coal-bearing rocks up to the top of the Coal Measures the writer finds a total thickness of at least 8,500 feet. This great mass of coal-bearing rocks consists of an alternation of slates, shales, sandstones, and coal beds, with their accompanying underbeds of fire clay. Only one small bed of limestone was observed. This occurs near the middle of the series; it is about 18 inches thick and quite arenaceous. The formation is naturally subdivided by seven or eight thick beds of sandstone, varying from 50 to 200 feet in thickness, the out-cropping edges of which form a series of more or less bold 'hog-back' ridges, the interbedded shales and slates forming the intervening valleys.

"The base of the coal series is a massive sandstone, ranging from 100 to 200 feet or more in thickness, lying immediately beneath the Grady coal bed, which is the lowest known coal. In the district embraced between the Missouri, Kansas and Texas railroad and the Arkansas State line, this sand rock usually forms a bold semi-mountainous ridge.

"This is the ridge through which the Saint Louis and San Francisco railroad passes at Bryan station, where the Grady coal bed is opened and worked, from which point it can be traced westward without difficulty, passing about 3 miles north of Le Flor on the same railroad, thence west to the Little Narrows (which is merely a gap in the ridge), and beyond to a point 2 miles west of the Thomson-McKinney place, where it swings abruptly north for a mile or more, only to resume immediately its westward course, forming for some miles the northern boundary of the valley known as the "Boiling Springs" prairie, beyond which it trends somewhat southwest, crossing Gaines' creek, thence west to, and south of, the Simpson place (2 or 3 miles east of the mining town of Krebs), where it abruptly turns back, running in an easterly course about 7 miles to Brushy creek, which it crosses, maintaining its eastward course for a further distance of about 6 miles, here forming the southern boundary of the Boiling Spring prairie, and the northern boundary of the Grady coal basin. From the point last reached the ridge swings around in a curve to the southwest, a distance of about 9 or 10 miles, inclosing and forming the valley and coal basin which has been named by the writer, after its discoverer, the Grady coal basin.

"In tracing this ridge eastwardly from the Bryan mine it is followed without difficulty to and beyond the Poteau river to a point about 5 miles nearly due south from Cavanal station. Here it turns abruptly back to the southwest, and swinging in a horseshoe curve to the south and southeast, incloses a basin which the writer has called the Mitchell basin, naming it likewise after its discoverer.

"The discovery of this basin furnishes a good example of the results that can, at times, be reached by the structural geologist in predicting, in advance of the actual examination of a district, what may possibly be found. Having traced this ridge to the Poteau river, and from an elevated point being able to see that it was running straight toward the Poteau mountains, some 10 or 15 miles to the east, and knowing that these mountains were formed of rocks high in the Coal Measures the writer saw at once that either a great fault must cut off these lower rocks, or that they must turn back to the west or southwest, and then, resuming their easterly course, pass south of the Poteau mountains. The first hypothesis being deemed improbable, the second was assumed to be probably true, in which case a coal basin should be found a few miles south of our camp on the Poteau river. Just as the writer was about starting in search of this basin, a courier reached camp with a message requiring my immediate return to McAlester. Upon leaving camp I gave my chief prospector (Mitchell) directions how to proceed in search of this basin, which he afterward found, without trouble, located exactly as the writer had predicted.

"A survey line, started from the ridge at Bryan and running nearly north directly across the dip to the Kavanaugh mountains, north of Kennedy's store, a distance of about 7 miles, would have the data for a cross section, from which the thickness of the Coal Measures could be obtained with accuracy.

"At Bryan the dip is about 40 degrees; at 1 mile north, about 30 degrees; at 2 miles north, about 20 degrees; and for the next 2 miles, about 15 to 20 degrees. Still farther north it gradually decreases until, under the main ridge or backbone of the Kavanaugh mountains, the rocks are flat. A section, roughly constructed from odometer measurements, gives a minimum thickness of 8,500 feet, with a possibility of 10,000 feet of coal-bearing rocks in this basin.

"Should the entire series prove of Carboniferous age the thickness here present is about twice as great as has yet been found in any State of the Union. Probably about the same thickness will be found in Arkansas, but up to the time my Indian Territory work was finished Mr. Winslow's work for the Arkansas Geological Survey had not progressed to a position warranting any definite statements as to total thickness, hence we were not able to compare results, but he already evidently anticipated the existence of a thickness far in excess of that shown in other States, and was not surprised to hear of a similar occurrence in the Indian Territory.

"The coals worked in the McAlester, Savannah, and Lehigh districts, on the Missouri, Kansas, and Texas railroad, and at Bryan, on the St. Louis and San Francisco railroad, belong to the lower portion of this 8,500 feet, being principally beds found within 1,500 feet of the basal sand rock.

"The coals of the Kavanaugh mountains, notably the big bed at

Mayberry's mine, and those in the mountain near Poteau switch, on the St. Louis and San Francisco railroad, belong high up in the series, being found in the uppermost 1,500 feet of rock. To this series, also, probably belong the coals opened and mined in the western part of Arkansas at Jenny Lind, Hackett City, and Huntington.

"The western Arkansas coals are dry semi-bituminous or semi-anthracite coals, mostly non-coking, or with quite feeble coking properties, ranging from 14 to 16 per cent. in volatile matter, the highest percentage yet found, according to Mr. Winslow's Arkansas report, being 17.655.

"In the Mitchell basin, about 10 miles west from the Arkansas line, coal recently opened shows 19 per cent. volatile matter; the Mayberry coal, about 8 miles farther west, contains 23 per cent. volatile matter, and the Bryan mine coal, about the same distance west, shows 26 per cent. volatile matter. About 30 miles farther west the coal shows from 38 to 41½ per cent. volatile matter, which is also about the percentage in coals of the McAlester and Lehigh districts.

"The Mitchell basin coal will coke; but whether it will make marketable coke has not yet been determined. From the Bryan mine west all the coals are strong coking coals; but they contain so much gas that the yield of coke will be small, except in the district between the Bryan mine and the Little Narrows. The coals best adapted for general use are found in the district lying at and west of the Little Narrows, in the Grady basin and in the McAlester field. The Mitchell basin coal, now being prospected, also promises coal of good quality, but of semi-bituminous character. A recent analysis, made by Prof. McCreath, gives the following result:

Analysis of coal from the Mitchell basin, Indian Territory.

	Per cent.
Water	1.058
Volatile matter	19.032
Fixed carbon	71.736
Sulphur	.649
Ash	7.525
Total	100.000

"The bed from which this sample was taken is supposed to be either the Grady or McAlester bed. The opening was made since my return, and I can not locate it.

"An average of seven analyses, made by Prof. McCreath, of coal from the Grady bed, in the Grady basin, shows:

Analysis of coal from the Grady basin, Indian Territory.

	Per cent.
Water	1.792
Volatile matter	40.207
Fixed carbon	51.785
Sulphur	1.333
Ash	4.883
Total	100.000

"Two analyses of coal from the Grady bed in the McKinney (Little Narrows) district, average:

Average analysis of coal from the McKinney district, Indian Territory.

	Per cent.
Water	1.709
Volatile matter	38.668
Fixed carbon	51.482
Sulphur	1.006
Ash	7.135
Total	100.000

"One analysis of coal from the McAlester bed at Krebs (near McAlester) gave:

Analysis of coal from the McAlester bed at Krebs, Indian Territory.

	Per cent.
Water	1.804
Volatile matter	37.171
Fixed carbon	53.404
Sulphur	.896
Ash	6.725
Total	100.000

"One analysis from Lehigh mines gave:

Analysis of coal from the Lehigh mines, Indian Territory.

	Per cent.
Water	4.323
Volatile matter	40.507
Fixed carbon	44.472
Sulphur	2.598
Ash	8.100
Total	100.000

"Both the Lehigh and Bryan mines produce coal objectionably high in sulphur; and the Lehigh coal has, moreover, the high percentage of moisture so common in the coals of Kansas and Missouri. The best coal now mined in the region is that from the McAlester bed, mined at

McAlester and Krebs by the Osage Mining Company, and at Alderson by the Choctaw Coal and Railway Company, and that from the Grady bed, just opened at Hartshorne by the latter company. These coals compare favorably with the best gas coals mined in the country (as comparison with standard Pittsburg coal will show), and they are by far the best coals now mined in the Southwest, if not indeed the best mined west of the Mississippi river. They are in every way vastly superior to Kansas, Missouri, and Iowa coals.

"Topographically and structurally the Choctaw coal fields represent in miniature many of the features of the anthracite region of Pennsylvania. The measures are flexed by a series of anticlinal and synclinal folds, not usually as sharp as those of the anthracite regions, but in many respects very similar. While all the anthracite basins are surrounded by a mountainous rim, of which the outcrop of the thick and massive conglomerate forms the core, the Choctaw basins are inclosed by a ridge, sharp and bold in places, but rarely mountainous, formed by the outcrop of the basal sandstone. Whether this rock is the equivalent of the conglomerate or not is as yet wholly conjectural.

"The writer has been enabled to compile the following generalized section of the Coal Measures from measurements rudely made and at points widely separated. In a general way it will be of service to the prospector or field geologist working in other portions of this coal field:

Columnar section of the Coal Measures of Indian Territory.

	Feet.
Shales and slates with two massive sandstone ledges. This group forms the backbone of the Kavanaugh Mountains north of Kennedy's store. Whether it contains coal beds is not now known. Its thickness is estimated at	1,200
Mayberry coal (this appears to be the Huntington-Jenny Lind coal)	4 to 6
Slates, sandstones, and shales, with some coal beds; none, however, known of workable size and quality; This group contains four or five massive sandstones. Its thickness is estimated at about	3,500
Slates with two massive sandstones (these form the top rocks in the center of the basin 4 miles southwest from Frinks switch on the M. K. and T. R. R.)	400
Sandstone	50
Slate	100
Secor coal	2½
Slate	30
Sandstone	50
Slates	320
Sandstone (forms ridge south of South McAlester)	200
Slates with thin coal bed	220
Sandstone (ridge at South McAlester)	100
Slates with sandstones	200
Sandstones (ridge between McAlester and South McAlester)	50
Slates	130
Norman coal	3
Slates with sandstone bed near top and two or three thin coals	600
McAlester coal	4
Sandstone	50
Slates and shales with thin coal bed	500
Sandstone, massive, caps Round Top and Long Mountain in the Grady basin, forms bold ridge half mile north of Alderson stations on Choctaw Coal and Railway Company's railroad. "Flat-top sandstone"	100
Slates and shales with two thin coals in upper part	600
Upper Grady coal, 1 to 3 feet Slates or sandstone, 50 feet Middle Grady coal, 1 to 3 feet Slates or sandstone, 50 feet Grady coal, 4 to 6 feet } Grady group of coals	100
Sandstone, massive "Tobocksy sandstone"	200

"Below this bottom sand rock we find shales and thin-bedded sandstones forming the Fourche valley, and including the 'Limestone ridge,' which is finely seen at Limestone Gap on the Missouri, Kansas and Texas railroad, and on the south side of the valley opposite the Little Narrows. These measures and the included limestone are probably of sub-Carboniferous age.

"The Grady coal basin is a beautiful little basin, inclosed on three sides by the ridge formed by the basal sand rock (Tobocksy sandstone) and on the fourth by the Adams ridge (formed by the 'Flat-top sandstone'), with but four narrow gaps through which entrance or egress may be had. A large part of the basin is flat or gently rolling, partly prairie and partly wooded. Near the center of this basin (exactly in its geological center) are three 'mountains' rising abruptly to a height of about 200 feet, almost perfectly flat on top and capped by a hard, massive sandstone, 30 feet or more in thickness, which outcrops in bold cliffs on all sides, making access to the top both difficult and dangerous.

"The maximum depth of the Grady coal bed in this basin is about 600 feet; but over three-fourths of the basin the bed can be reached at depths less than 450 feet, and over one-half of the basin the depth will probably not exceed 300 feet. The basin is about 6 miles long by 3 or 4 wide, and contains over 11,000 acres of the Grady bed. Throughout this area the coal is not always of workable thickness; but over a large portion of it the bed will range from 3½ to 5 feet thick, yielding an average of 4 feet of clear coal.

"The axial line of the Kavanaugh mountains is a synclinal with a gentle anticlinal roll occupying the valley of Brazil creek, and another similar roll coinciding very nearly with the course of the Poteau river from Cavanal to and beyond Poteau station. These anticlinal rolls apparently have a general course of south forty degrees west, while the main synclinals run about south seventy degrees west to south eighty degrees west. The same feature was noticed in the McAlester and Grady basin districts, and seems to indicate two distinct types of disturbances, or, what is perhaps more probable, a single flexing force, giving rise to two series of rolls along the lines of two distinct resultants.

"Whatever the cause, the existence of two series of anticlinal and synclinal folds, not parallel, but forming an angle of thirty or forty degrees, is a fact that should not be overlooked, for it has a most important bearing upon the shape of the basins, and upon the location of those minor disturbances—roll and faulted areas—an intelligent anticipation of which may often avert the loss of large sums expended in attempting to open and operate collieries located in or near such a disturbed area.

"In a general way we may expect faulted coal, rolls, and swamps at and near the intersection of any two synclinal or anticlinal axes. Thus such an area is found along Brushy creek, immediately west southwest from the Grady basin. At the southwest corner of the Grady basin the 'butt end' of an anticlinal axis is plainly shown by the indentation of the southern rim immediately west of Hartshorne station. This axis apparently runs about south twenty degrees or twenty-five degrees west.

"In prospecting for coal in this field, the first object is, of course, to find a bed of good quality, and thick enough for profitable mining. As in the McAlester and Lehigh districts coal averaging almost 4 feet in thickness is mined, and as from 4 to 6 feet of coal is worked in the Arkansas fields, a thickness of not less than 3 feet and 6 inches is needed to place a new establishment on anything like an equal footing with these older companies.

"Cheap mining, and the production of as large a percentage of lump coal as possible, require also that the dip of the coal shall be moderate, not exceeding a pitch of about 14 or 15 degrees, so that the mine cars may be taken directly to the face of the breasts or rooms. A pitch of 6 or 8 degrees is considered most advantageous, as on such a pitch slopes work well, and the cars are readily taken up to the working face.

"When the dip is less than 6 or 8 degrees, the best method of development is by shafts.

"Hence, in searching for coal in this field, the prospector rapidly passes, as undesirable, all territory in which the rocks show a strong angle of dip, and upon reaching an area of moderate dip his search may profitably be confined to the outcrops of the three beds above named.

"The Boiling Springs prairie, and the same valley farther east, where it is known as the Fourche Melane valley, or valley of the 'Big Fourche,' is not coal territory. It is occupied by the shales associated with the limestone of 'Limestone ridge,' which are possibly of sub-Carboniferous age."

Production.—The amount and value of coal produced in Indian Territory in 1889 and 1890, with the distribution of the product, is shown in the following table:

Coal product of Indian Territory in 1889 and 1890.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
1889	699,122	7,095	33,997	12,618	752,832	$1,323,807	....	1,862
1890	828,102	6,211	11,292	23,624	869,229	1,579,188	238	2,571

No record of the production of the Indian Territory coal fields was made prior to 1885. Since that date the product has been as follows:

Product of coal in the Indian Territory from 1885 to 1890, inclusive.

Years.	Short tons.	Years.	Short tons.
1885	500,000	1888	761,986
1886	534,580	1889	752,832
1887	685,911	1890	869,229

IOWA.

Total product in 1889, 4,095,358 short tons; spot value, $5,426,509. Total product in 1890, 4,021,739 short tons; spot value, $4,995,739.

The production of coal in Iowa in 1889 was 857,082 short tons less than that of 1888, and showed a decrease in value of $1,011,663. A further decrease is noted in 1890 of 73,619 short tons in amount and $430,770 in value.

Owing to the large number of small mines in Iowa, considerable difficulty has been experienced in obtaining the statistics of production. Many of the small operators keep no systematic records, and the statements from these mines are necessarily estimated.

The following tables show the production in 1889 and 1890 by counties, with the distribution of the product.

Coal product of Iowa in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Adams	800	12,637	20		13,457	$27,870	
Appanoose	252,881	25,837	6,476		285,194	376,473	1,044
Boone	125,858	44,479	4,030	25	174,392	324,302	653
Cass		280			280	700	
Dallas	60,309	5,576	1,170		67,055	111,472	
Davis		3,820	5		3,825	5,409	
Greene	41,429	6,772	3,237		51,438	89,704	175
Guthrie		12,275			12,275	30,852	
Hardin		490			490	1,370	
Jasper	171,120	17,853	10,179		199,152	282,081	464
Jefferson	3,341	4,728	54		8,123	12,609	
Keokuk	417,751	18,765	18,646		455,162	569,190	890
Lucas	318,523	10,316	10,390		339,229	416,807	704
Mahaska	992,393	42,296	21,788		1,056,477	1,222,954	1,648
Marion	124,325	19,523	1,332		145,180	185,266	349
Monroe	244,306	8,589	5,506		258,401	300,786	690
Montgomery		1,040			1,040	2,280	
Page		2,766	2		2,768	6,770	
Polk	284,310	138,876	10,861		434,047	687,969	1,020
Scott		9,446			9,446	15,181	
Taylor	3,800	5,936			9,736	20,122	
Van Buren	34,891	3,906	461		39,258	54,617	89
Wapello	331,702	22,833	4,652	12	359,109	406,445	726
Warren	4,984	9,331	200		14,515	25,819	
Wayne	7,489	9,811	180		17,480	25,751	
Webster	110,161	26,554	1,024		137,739	224,210	414
Total	3,580,378	464,735	100,213	37	4,095,358	5,426,509	9,247

Coal product of Iowa in 1890, by counties,

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Appanoose	252, 970	25, 339	6, 251	284, 560	$392, 053	165	1, 060
Boone	121, 783	28, 833	2, 613	153, 229	279, 192	191	465
Dallas	26, 439	3, 927	3, 100	33, 466	57, 059	207	130
Greene	45, 031	161	....	45, 192	73, 674	209	121
Jasper	165, 240	5, 760	2, 044	173, 044	191, 775	246	335
Jefferson and Lucas	350, 800	800	....	351, 600	439, 900	298	324
Keokuk	328, 435	11, 811	9, 072	349, 318	458, 608	184	1, 018
Mahaska	1, 072, 688	12, 993	18, 150	1, 103, 831	1, 165, 861	258	1, 673
Marion	147, 013	6, 213	280	153. 506	192, 714	265	260
Monroe	308, 959	6, 711	8, 361	324, 031	390, 969	197	735
Polk	216, 463	142, 027	9, 362	367, 852	547, 272	243	700
Van Buren	42, 934	3, 690	840	47, 464	61, 180	280	108
Wapello	336, 284	2, 448	3, 200	341, 932	376, 928	159	773
Warren	5, 790	2, 640	40	8, 470	14, 306	204	38
Wayne	24, 355	975	85	25, 415	31, 769	180	60
Webster	115, 554	3, 175	100	118, 829	182, 479	182	307
Small mines	....	140, 000	....	140, 000	140, 000	....	....
Total	3, 560, 738	397, 503	63, 498	4, 021, 739	4, 995, 739	(*a*)213	8, 130

a Average for the State.

The State is divided into three inspection districts, known respectively as the southern or first district, the northeastern or second district, and the northwestern or third district. In previous volumes of Mineral Resources the annual production of the State since 1883 has been given by districts and for the sake of comparison the tables are carried up to 1890.

Total production of coal in Iowa by districts from 1883 to 1890, inclusive.

Districts.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Short tons.*	*Short tons.*
First	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841	1, 528, 967	1, 497, 685	1, 536, 978
Second	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978	1, 974, 352	1, 720, 727	1, 626, 193
Third	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671	918, 503	876, 946	718, 568
Small mines	....	....	....	....	....	....	....	140, 000
Total	3, 979, 946	3, 902, 291	3, 582, 656	3, 853, 374	3, 994, 490	4, 421, 822	4, 095, 358	4, 021, 739

Product of coal in the first inspection district of Iowa from 1883 to 1890, inclusive.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Short tons.*	*Short tons.*
Appanoose	128, 896	158, 986	245, 896	150, 000	160, 351	210, 263	285, 194	284, 560
Adams	3, 891	3, 981	3, 896	9, 581	19, 851	18, 817	13, 457	(*a*)
Cass	....	....	....	....	....	....	280	(*a*)
Davis	527	1, 207	33, 655	1, 000	1. 800	1, 800	3, 825	(*a*)
Jefferson	38, 887	8, 172	1, 116	1, 083	10, 397	9. 387	8. 123	351, 600
Lucas	487. 821	410, 729	439. 956	530, 759	472. 998	364. 969	339, 229	
Marion	90, 985	97, 085	100, 011	141, 694	212. 695	230, 652	145. 180	153, 506
Monroe	93, 435	98, 427	101, 517	117, 700	183, 505	233, 896	258, 401	324, 031
Montgomery	....	....	....	....	....	....	1, 040	(*a*)
Page	748	1, 009	1, 819	1, 550	1, 780	3, 430	2, 768	(*a*)
Taylor	94	127	617	8, 585	12, 180	8, 002	9, 736	(*a*)
Van Buren	1, 678	1, 778	1, 193	8, 038	26, 331	25. 960	39, 258	47, 464
Wapello	237, 821	240, 720	187, 911	237, 111	272, 073	380, 395	359, 199	341, 932
Warren	12, 828	13, 727	12, 825	23, 332	24, 796	17, 103	14, 515	8, 470
Wayne	1, 892	4, 947	25, 812	34, 000	28, 084	24, 293	17, 480	25, 415
Total	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841	1, 528, 967	1, 497, 685	*b*1, 536, 978

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the second inspection district of Iowa from 1883 to 1890.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Short tons.*	*Short tons.*
Mahaska	927, 387	932, 714	762, 785	851, 362	1, 025, 548	835, 981	1, 056, 477	1, 103, 831
Keokuk	500, 040	430, 940	372, 816	545,304	599, 007	541, 966	455, 162	349, 318
Jasper	45, 883	46, 336	90, 425	286, 034	142, 039	275, 179	199, 152	173, 044
Scott	3, 714	3, 821	5, 937	3, 000	8, 634	9, 080	9, 446	(*a*)
Marshall	....	....	....	400	200	....	....	....
Hardin	....	....	....	2, 000	450	1, 000	490	(*a*)
Muscatine	....	....	....	100	100	....	....	....
Total	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978	1, 663, 206	1, 720, 727	*b*1, 626, 193

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the third inspection district of Iowa from 1883 to 1890.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Short tons.*	*Short tons.*
Boone	466, 981	473, 073	458, 191	294, 970	167, 068	140, 142	174, 392	153, 229
Dallas	38, 208	37, 185	32, 986	21, 986	40, 420	48, 622	67, 055	33, 466
Greene	88, 851	96, 327	89, 587	117, 538	105, 894	106, 042	51, 438	45, 192
Guthrie	....	5. 187	4, 596	17, 194	18, 305	18, 680	12, 275	(*a*)
Hamilton	1, 998	1, 878	918	3, 312	6, 669	6, 480	....	....
Polk	558, 821	619, 921	462, 895	337, 964	305, 094	300, 669	434, 047	367, 852
Webster	248, 560	214, 014	145, 296	107, 777	146, 221	159, 715	137, 739	118, 829
Story	....	....	....	....	2, 000	2, 000	....	....
Total	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671	785, 350	876, 946	*b*718, 568

a Included in product of small mines. *b* Exclusive of product of small mines.

Résumé.—In the foregoing tables the product for the years previous to 1889 has been given in long tons, while that of 1889 and 1890 is given in short tons. In the following table the product for all the years from 1883 to 1890 is given in short tons:

Product of coal in Iowa from 1883 to 1890.

Years.	Short tons.	Years.	Short tons.
1883	4, 457, 540	1887	4, 473, 829
1884	4, 370, 566	1888	4, 952, 440
1885	4, 012, 575	1889	4, 095, 358
1886	4, 315, 781	1890	4, 021, 739

KANSAS.

Total product in 1889, 2,221,043 short tons; spot value, $3,296,888.
Total product in 1890, 2,259,922 short tons; spot value, $2,947,517.

As shown in the following tables, the principal producing counties in the State are Cherokee, Crawford, Leavenworth, and Osage, the other producing counties having a combined total product of but little more than 35,000 short tons. In 1888 Cherokee county was the first in producing importance, Osage, Crawford, and Leavenworth following in the order named. In 1889 Crawford county took the lead with a product of 827,159 short tons, Cherokee coming second with 549,073 short tons, Osage third with 446,018 short tons, and Leavenworth fourth with 245,616 short tons. In 1890 the order is again changed, Crawford county holding the lead and Cherokee the second place, Osage and Leavenworth changing places, the product for each being—Crawford, 900,464; Cherokee, 724,861; Leavenworth, 319,866; Osage, 179,012.

A description of the Kansas coal fields, by Mr. Braidwood, was published in Mineral Resources for 1888.

The following tables show the product of coal in Kansas in 1889 and 1890, with the value and distribution:

Coal product of Kansas in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Bourbon		19, 150			19, 150	$32, 092	
Chautauqua		4, 274			4, 274	12, 451	
Cherokee	516, 616	24, 878	7, 079	500	549, 073	662, 858	1, 196
Cloud		8. 454	21		8. 475	21, 496	
Coffey	1, 602	16, 670			18, 272	35, 488	25
Crawford	812, 700	8, 546	5, 913		827, 159	971, 857	1, 629
Ellsworth		5, 390			5, 390	17, 026	
Franklin	10, 666	27, 105			37, 771	82, 499	(*a*) 75
Jewell		800			800	2, 400	
Labette	80	2, 461			2, 541	5, 773	(*b*)
Leavenworth	174, 567	57, 239	13, 820		245, 616	415, 751	937
Lincoln		6, 427			6, 427	20, 723	
Linn	12, 401	12, 864	80		25, 345	33, 665	62
Lyon		4, 365			4, 365	12, 160	
Mitchell		960			960	3, 840	
Nemaha		2. 171			2. 171	7, 870	
Osage	362, 468	81, 217	2, 333		446, 018	903, 602	2, 032
Republic		986			986	2, 710	
Russell		6, 703			6, 703	22, 065	
Shawnee		9, 547			9, 547	30, 562	
Total	1, 891, 090	300, 207	29, 246	500	2, 221, 043	3, 296, 888	5, 956

a Including Labette county. *b* Included in Franklin county.

Coal product of Kansas in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Cherokee	710, 580	11, 968	2, 313	724, 861	882, 186	186	1, 413
Coffey	200	12, 000		12, 200	17, 000	187	22
Crawford	891, 634	6, 170	2, 660	900, 464	1, 114, 701	198	1, 447
Labette		4, 000		4, 000	10, 000	200	10
Franklin	5, 400	3, 610	35	9, 045	18, 130	224	47
Leavenworth	255, 431	62, 995	1, 440	319, 866	490, 224	273	745
Osage	156, 815	22, 062	135	179, 012	242, 198	209	804
Linn	8, 040	2. 034	400	10, 474	14, 078	164	60
Small mines		100, 000		100, 000	150, 000		
Total	2, 028, 100	224, 839	6, 983	2, 259, 922	2, 947, 517	(*a*) 210	4, 523

a Average for the State.

KENTUCKY.

Total product in 1889, 2,399,755 short tons; spot value, $2,374,339.
Total product in 1890, 2,701,496 short tons; spot value, $2,472,119.

The product of coal in 1889 was 170,245 short tons less than that of 1888. In 1890 the product was 301,741 short tons more than in 1889, and greater than that of any previous year. According to the census returns the number of country banks operated in Kentucky in 1889 was 1,762, which produced 170,862 short tons of coal—which amount is included in the product statement below. While the number of these small openings varies from year to year, some being abandoned in a very short time, and others started up, the amount of coal taken from them does not materially change except by reason of an exceptionally mild winter season, when little coal is needed, or when an unusually cold season produces the opposite effect. It is estimated that about 180,000 tons were obtained from these mines in 1890. The placing of a value upon this product is purely a matter of guesswork. Most of it is consumed by the man who digs it, who may or may not own the land, and who sometimes pays for it and as frequently does not.

The production of coal in Kentucky, by counties, for 1889 and 1890, with the value and distribution of the product, is shown in the following tables:

Coal product of Kentucky in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Bell	3,270	13,198	57	3,570	20,095	$28,144
Boyd	161,030	2,094			163,124	179,385
Breathitt		353			353	324
Butler		6,489			6,489	8,054
Carter	167,301	3,777	1,698		172,776	196,892
Christian	23,154	1,127	3,000		27,281	34,348
Clay		5,170			5,170	6,207
Crittenden	3,976	1,310			5,286	5,604
Daviess		30,794	76		30,870	40,231
Edmonson		78			78	78
Elliott		1,100			1,100	1,247
Floyd		2,236			2,236	2,433
Grayson		492			492	615
Greenup		632			632	792
Hancock	16,110	5,478			21,588	34,087
Harlan		785			785	820
Henderson	39,473	24,651	1,558		65,682	82,457
Hopkins	508,927	23,328	7,976	14,888	555,119	434,606
Jackson		568			568	568
Johnson	24 544	7,555	248		32,847	54,178
Knott		1,158			1,158	1,052
Knox and Lee	47,503	1,200			48,703	42,200
Laurel	273,244	6,904	303		280,451	251,122
Lawrence	77,683	2,104			79,787	107,103
Leslie		1,271			1,271	1,271
Letcher		1,573			1,573	1,257
McLean	23,345	11,812	20		35,177	41,199
Madison		175			175	265
Magoffin		5,404			5,404	6,623
Martin		660			660	800
Menifee		1,160			1,160	1,450
Morgan		1,061			1,061	1,061
Muhlenberg	194,339	11,314	1,202		206.855	180,654
Ohio	221,385	22,667	2,201		246,253	200,497

Coal product of Kentucky in 1889, by counties—Continued.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Owsley	....	2,201	....	....	2,201	$2,751
Perry	....	349	....	....	349	349
Pike	....	1,962	....	....	1,962	1,962
Powell	....	69	....	....	69	69
Pulaski	78,420	2,743	3,200	....	84,363	109,587
Rockcastle	....	1,432	....	....	1,432	1,790
Todd	....	530	....	....	530	663
Union	41,278	13,924	1,354	....	56,556	63,803
Wayne	....	1,457	....	....	1,457	1,821
Webster	26,776	5,947	6	....	32,729	26,379
Whitley	179,252	4,540	1,082	....	184,874	203,264
Wolfe	....	11,474	....	....	11,474	14,277
Total	2,111,010	246,306	23,981	18,458	2,399,755	2,374,339

Coal product of Kentucky in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Butler, Christian, Crittenden, and Daviess	42,363	900	1,668	....	44,931	$41,652	164	152
Boyd and Pulaski	188,027	3,473	100	....	191,600	163,176	275	312
Carter	175,670	960	2,749	....	179,379	197,027	237	459
Hancock, Henderson, and McLean	122,400	3,040	1,200	....	126,640	126,550	224	206
Hopkins	557,937	13,532	10,565	22,273	604,307	461,177	231	1,104
Johnson	20,822	400	....	....	21,222	45,234	267	110
Knox	89,200	800	....	....	90,000	69,600	240	200
Laurel	234,490	55,430	1,258	....	291,178	276,718	225	680
Muhlenberg	218,835	14,460	7,688	....	240,983	193,830	213	495
Ohio	262,720	3,700	1,316	....	267,736	208,072	236	520
Union	56,587	11,176	....	....	67,763	72,999	189	131
Webster and Lawrence	129,723	2,069	1,424	....	133,216	149,860	264	265
Whitley	259,215	1,726	1,600	....	262,541	286,724	204	625
Small mines	....	180,000	....	....	180,000	180,000	....	....
Total	2,357,989	291,666	29,568	22,273	2,701,496	2,472,119	(*a*) 219	5,259

a Average for the State.

Coal product of Kentucky in 1890, by districts.

Districts.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons*	*Short tons.*		
Jellico	348,415	2,526	1,600	....	352,541	$356,324	825
Laurel	234,490	55,430	1,258	....	291,178	276,718	680
Pine Hill and Coalton	363,697	4,433	2,849	....	370,979	360,203	771
Peach Orchard	118,822	1,400	1,200	....	121,422	170,234	310
Kentucky	1,292,565	47,877	22,661	22,273	1,385,376	1,128,640	2,643
Small mines	....	180,000	....	....	180,000	180,000	....
Total	2,357,989	291,666	29,568	22,273	2,701,496	2,472,119	5,259

The following table shows the annual product of coal in Kentucky from 1873 to 1890:

Product of coal in Kentucky from 1873 to 1890.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	300,000	1879	1,000,000	1885	1,600,000
1874	360,000	1880	1,000,000	1886	1,550,000
1875	500,000	1881	1,100,000	1887	1,933,185
1876	650,000	1882	1,300,000	1888	2,570,000
1877	850,000	1883	1,650,000	1889	2,399,755
1878	900,000	1884	1,550,000	1890	2,701,496

MARYLAND.

Total product in 1889, 2,939,715 short tons; spot value, $2,517,474. Total product in 1890, 3,357,813 short tons; spot value, $2,899,572.

Owing to the disastrous flood of 1889, which almost destroyed the Chesapeake and Ohio canal, one of the chief means of transportation for Maryland coal, was removed and the product for that year was 539,755 short tons less than in 1888. Additional railroad facilities—not by the construction of new roads but by an increase in the number of cars—enabled the trade to recover somewhat in 1890, and the rebuilding of the canal in 1891 will afford means of moving a still larger product in that year.

The production is limited to two counties in the State, Allegany and Garrett, the product of the latter being insignificant when compared with that of Allegany. The amount and value of coal produced in 1889 and 1890, with the distribution of the product is shown in the following tables:

Coal product of Maryland in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average number employed
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*		
Allegany	2,885,114	39,805	10,162	2,935,081	$2,512,614	3,702
Garrett	222	4,412	....	4,634	4,860	
Total	2,885,336	44,217	10,162	2,939,715	2,517,474	3,702

Coal product of Maryland in 1890.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Allegany	3, 296, 393	44, 621	8, 799	3, 349, 813	$2, 893, 172	244	3, 842
Small mines	....	8, 000	....	8, 000	6, 400	....	....
Total	3, 296, 393	52, 621	8, 799	3, 357, 813	2, 899, 572	244	3, 842

In the 1888 volume of Mineral Resources a statement is made showing the product in long tons of the individual companies operating in Maryland from 1883 to 1888. The agreement made by the Census Office and in the collection of the statistics for 1890 precludes the publishing of the same reports for 1889 and 1890. The amounts are therefore summarized for the years in the following table, and for convenience of comparison are reduced to short tons:

Product of coal in Maryland from 1883 to 1890.

Years.	Short tons.	Years.	Short tons.
1883	2, 476, 075	1887	3, 278, 023
1884	2, 765, 617	1888	3, 479, 470
1885	2, 833, 337	1889	2, 939, 715
1886	2, 517, 577	1890	3, 357, 813

In the following table the statistics for 1889 and 1890 are taken from the report of the Cumberland coal trade, furnished by Mr. H. W. Shaidt, manager of the Cumberland Daily News. The product for 1890 is slightly in excess of the returns made to the survey:

Product of coal in Maryland for eight years.

Companies.	1883.	1884.	1885.	1886.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	456, 238	689, 212	710, 064	675, 652
New Central Coal Company	210, 850	210, 140	203, 814	149, 561
Georges Creek Coal and Iron Company	257, 490	266, 042	257, 348	265, 942
Maryland Union Coal Company	137, 105	117, 180	98, 095	116, 771
Borden Mining Company	151, 665	162, 057	179, 537	137, 747
Maryland Coal Company	235, 854	295, 736	365, 319	288, 742
American Coal Company	190, 055	194, 330	220, 339	211, 305
Potomac Coal Company	139, 723	169, 463	196, 280	156, 757
Hampshire and Baltimore Coal Company	194, 534	36, 416	....	....
Atlantic and Georges Creek Coal Company (Pekin mine)	69, 000	75, 467	64, 938	7, 321
Swanton Mining Company	34, 905	28, 620	52, 862	42, 688
Blæn Avon Coal Company	84, 721	100, 961	69, 192	65, 330
Piedmont Coal and Iron Company	4, 619	1, 250	32	1, 678
Union Mining Company	5, 024	5, 310	5, 641	6, 824
National Coal Company	38, 998	42, 680	48, 307	62, 637
Davis & Elkins mine	....	74, 487	58, 002	58, 382
Total	2, 210, 781	2, 469, 301	2, 529, 765	2, 247, 837

Product of coal in Maryland for eight years—Continued.

Companies.	1887.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	936, 799	1, 023, 349	871, 463	956, 031
New Central Coal Company	181, 906	169, 484	118, 885	218, 169
Georges Creek Coal and Iron Company	394, 012	437, 992	311, 258	351, 310
Maryland Union Coal Company	148, 523	106, 620	....	....
Borden Mining Company	192, 636	212, 520	206, 549	290, 055
Maryland Coal Company	316, 518	340, 866	268, 438	366, 839
American Coal Company	259, 632	287, 058	297, 537	386, 731
Potomac Coal Company	209, 793	208, 777	205, 212	217, 232
Atlantic and Georges Creek Coal Company (Pekin mine)	....	6, 375	3, 884	752
Swanton Mining Company	61, 610	58, 383	40, 748	41, 401
Blaen Avon Coal Company	11, 934	....	....	....
Union Mining Company	7, 500	6, 306	3, 734	17, 933
National Coal Company	117, 775	76, 592	72, 571	60, 206
Davis & Elkins mine	82, 667	98, 443	18, 089	....
James Ryan	3, 608	....	....	....
George M. Hansel	1, 989	3, 550	113	....
Barton and Georges Creek Valley Company	....	69, 857	123, 429	175, 838
Enterprise mine	....	399	288	11
Franklin Consolidated Coal Company	....	....	71, 837	66, 644
Big Vein Coal Company	....	....	21, 310	52, 917
Piedmont-Cumberland Coal Company	....	....	2, 493	29, 003
Anthony Mining Company	....	....	....	115
Total	2, 926, 902	3, 106, 670	2, 637, 838	3, 231, 187

Total shipments from the Cumberland coal field in

Years.	Frostburg region.						
	Cumberland and Pennsylvania railroad.				Cumberland Coal and Iron Company's railroad.		
	By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Total.	By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1842	757	....	....	757	951	....	951
1843	3, 661	....	....	3, 661	6, 421	....	6, 421
1844	5, 156	....	....	5, 156	9, 734	....	9, 734
1845	13, 738	....	....	13, 738	10, 915	....	10, 915
1846	11, 240	....	....	11, 240	18, 555	....	18, 555
1847	20, 615	....	....	20, 615	32, 325	....	32, 325
1848	36, 571	....	....	36, 571	43, 000	....	43, 000
1849	63, 676	....	....	63, 676	78, 773	....	78, 773
1850	73, 783	3, 167	....	76, 950	119, 023	875	119, 898
1851	70, 893	51, 438	....	122, 331	103, 808	31, 540	135, 348
1852	128, 534	46, 357	....	174, 891	139, 925	19, 362	159, 287
1853	150, 381	84, 060	....	234, 441	155, 278	70, 535	225, 813
1854	148, 953	63, 731	....	212, 684	173, 580	92, 114	265, 694
1855	93, 691	77, 095	....	170, 786	97, 710	100, 691	198, 401
1856	86, 994	80, 387	....	167, 381	121, 945	105, 149	227, 094
1857	80, 743	55, 174	....	135, 917	88, 573	54, 000	142, 573
1858	48, 018	166, 712	....	214, 730	66, 009	87, 539	153, 548
1859	48, 415	211, 639	....	260, 054	72, 423	86, 203	158, 626
1860	70, 669	232, 278	....	302, 947	80, 500	63, 600	144, 100
1861	23, 878	68, 303	....	92, 181	25, 983	29, 296	55, 279
1862	71, 745	75, 206	....	146, 951	41, 096	23, 478	64, 574
1863	117, 796	173, 269	....	291, 065	111, 087	43, 523	154, 610
1864	287, 126	194, 120	....	481, 246	67, 676	64, 522	132, 198
1865	384, 297	285, 295	....	669, 592	104, 651	57, 907	162, 558
1866	592, 938	291, 019	....	883, 957	52, 251	52, 159	104, 410
1867	623, 031	385, 249	....	1, 008, 280	40, 106	72, 904	113, 010
1868	659, 115	424, 406	....	1, 083, 521	100, 345	57, 919	158, 264
1869	1, 016, 777	573, 243	....	1, 590, 029	130, 017	78, 908	208, 925
					2, 092, 660	1, 192, 224	3, 284, 884
					Cumberland Branch.		
1870	909, 511	520, 196	....	1, 429, 707	114, 404	83, 941	198, 345
1871	1, 247, 279	656, 085	....	1, 903, 364	69, 864	194, 254	264, 118
1872	1, 283, 956	612, 537	22, 021	1, 918, 514	26, 586	203, 666	230, 252
1873	1, 509, 570	641, 220	114, 589	2, 265, 379	89, 765	137, 582	227, 347
1874	1, 295, 804	631, 882	67, 671	1, 995, 357	113, 670	135, 182	248, 852
1875	1, 095, 880	715, 673	160, 213	1, 971, 766	52, 505	164, 165	216, 670
1876	939, 262	443, 435	131, 866	1, 514, 563	15, 285	189, 005	204, 290
1877	755, 278	473, 646	170, 884	1, 399, 808	63, 181	111, 350	174, 531
1878	823, 801	486, 038	145, 864	1, 455, 703	99, 455	123, 166	222, 621
1879	933, 240	397, 009	154, 264	1, 484, 513	141, 907	104, 238	246, 145
1880	1, 055, 491	471, 800	213, 446	1, 740, 737	197, 525	131, 325	328, 850
1881	1, 113, 263	270, 156	153, 501	1, 536, 920	271, 570	151, 526	423, 096
1882	576, 701	115, 344	91, 574	783, 619	199, 183	76, 140	275, 323
1883	851, 985	302, 678	217, 065	1, 371, 728	197, 235	141, 390	338, 625
1884	1, 193, 780	150, 471	199, 138	1, 543, 389	289, 884	124, 718	414, 602
1885	1, 091, 904	171, 460	206, 227	1, 469, 591	289, 407	117, 829	407, 236
1886	1, 131, 949	115. 531	141, 520	1, 389, 000	243, 321	113, 791	357, 112
1887	1, 584, 114	132, 177	176, 241	1, 892, 532	332, 798	125, 305	458, 103
1888	1, 660, 406	155, 216	193, 046	2, 208, 668	374, 888	95, 191	470, 079
1889	1, 430, 381	26, 886	177, 152	1, 634, 419	368, 497	26, 407	394, 904
1890	1, 511, 418	....	291, 704	1, 803, 122	(*d*)522, 334	....	522, 334
Total	28, 926, 454	11, 051, 588	3, 027, 976	42, 985, 998	4, 073, 264	2, 550, 071	6, 623, 335

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a Of this amount 35,149 long tons were shipped to the Chesapeake and Ohio canal via Piedmont,

b Includes 78,045 long tons used on line of Cumberland and Pennsylvania railroad and its branches, pany in locomotives, rolling mills, etc.

c The total shipments of the Cumberland coal field reported by the railroads is 63 long tons greater company.

d Of this amount 3,744 tons were shipped to the Pennsylvania railroad.

e Of this amount 307,750 tons were shipped to the Pennsylvania railroad.

f Includes 95,753 tons used on line of Cumberland and Pennsylvania railroad and its branches, and rolling mills, etc.

Maryland and West Virginia for forty-nine years.

Frostburg region.				Piedmont region.		Total.			
Georges Creek and Cumberland railroad.									
By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Local and Baltimore and Ohio.	Total.	George's Creek railroad.	Hampshire railroad, by Baltimore and Ohio railroad.	Baltimore and Ohio railroad and local.	Chesapeake and Ohio canal.	Pennsylvania railroad.	Aggregate.
Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
......	......	......	......	......	......	1,708	......	......	1,708
......	......	......	......	......	......	10,082	......	......	10,082
......	......	......	......	......	......	14,890	......	......	14,890
......	......	......	......	......	......	24,653	......	......	24,653
......	......	......	......	......	......	29,795	......	......	29,795
......	......	......	......	......	......	52,940	......	......	52,940
......	......	......	......	......	......	79,571	......	......	79,571
......	......	......	......	......	......	142,449	......	......	142,449
......	......	......	......	......	......	192,806	4,042	......	196,848
......	......	......	......	......	......	174,701	82,978	......	257,679
......	......	......	......	......	......	268,459	65,719	......	334,178
......	......	......	......	73,725	......	376,219	157,760	......	538,979
......	......	......	......	181,803	......	508,836	155,845	......	650,681
......	......	......	......	227,245	65,570	478,486	183,786	......	662,272
......	......	......	......	269,210	42,765	502,330	204,120	......	706,450
......	......	......	......	252,368	51,628	465,912	116,574	......	582,486
......	......	......	......	218,318	63,060	395,405	254,251	......	649,656
......	......	......	......	257,740	47,934	426,512	297,842	......	724,354
......	......	......	......	289,298	52,564	493,031	295,878	......	788,909
......	......	......	......	85,554	36,660	172,075	97,599	......	269,674
......	......	......	......	69,482	36,627	218,950	98,684	......	317,634
......	......	......	......	266,430	36,240	531,553	216,792	......	748,345
......	......	......	......	......	44,552	399,354	258,642	......	657,996
......	......	......	......	......	71,345	560,293	343,202	......	903,495
......	......	......	......	......	90,964	736,153	343,178	......	1,079,331
......	......	......	......	......	72,532	735,669	458,153	......	1,193,822
......	......	......	......	......	88,658	848,118	482,325	......	1,330,443
......	......	......	......	......	83,724	1,230,518	652,151	......	1,882,669
				(*a*) 2,190,673					
				Empire and West Virginia mines.					
......	......	......	......	28,035	60,988	1,112,938	604,137	......	1,717,075
......	......	......	......	81,218	96,453	1,494,814	850,339	......	2,345,153
......	......	......	......	85,441	121,864	1,517,347	816,103	22,021	2,355,471
......	......	......	......	77,582	103,793	1,780,710	778,802	114,589	2,674,101
......	......	......	......	57,492	109,194	1,576,160	767,064	67,671	2,410,895
......	......	......	......	63,537	90,800	1,302,237	879,838	160,698	2,342,773
......	......	......	......	108,723	7,506	1,070,775	632,440	131,866	1,835,081
......	......	......	......	......	......	818,459	584,996	170,884	1,574,339
......	......	......	......	......	998	924,254	609,204	145,864	1,679,322
......	......	......	......	......	51	1,075,198	501,247	154,264	1,730,709
......	......	......	......	66,573	......	1,319,589	603,125	213,446	2,136,160
83,136	125,097	4,947	213,180	88,722	......	1,478,502	504,818	278,598	2,261,918
78,298	93,861	31,436	203,595	277,929	......	1,065,249	269,782	185,435	1,540,466
215,767	202,223	77,829	495,819	338,001	......	1,444,766	680,119	419,288	2,544,173
69,765	156,959	283,336	510,060	466,928	......	2,233,928	344,954	356,097	2,934,979
79,455	214,518	291,685	585,658	403,489	......	2,076,485	368,744	420,745	2,865,974
53,480	98,371	348,196	500,047	346,308	......	(*b*) 2,069,774	282,802	239,891	2,592,467
4,863	153,230	418,057	576,150	449,011	......	2,724,347	262,345	389,104	(*c*) 3,375,796
112	286,787	341,024	627,923	564,397	......	2,669,216	286,700	715,151	3,671,067
......	365,029	243,487	608,516	576,047	......	2,357,585	57,459	798,842	3,213,886
......	677,593	228,138	905,731	(*e*) 774,904	......	(*f*) 2,723,341	......	1,282,748	4,006,091
584,876	2,373,668	2,268,135	5,226,679	4,854,339	1,475,969	44,922,144	15,454,539	6,267,202	66,643,885

Baltimore and Ohio railroad, to Cumberland.

by Cumberland and Piedmont; also 280,850 long tons used by the Baltimore and Ohio Railroad Con

than the total shipments shown in the table already given exhibiting the shipments of each co

at Cumberland and Piedmont; also, 440,268 tons used by the Baltimore and Ohio railroad in locomotive

MICHIGAN.

Total product in 1889, 67,431 short tons; spot value, $115,011.

Total product in 1890, 74,977 short tons; spot value, $149,195.

Although the coal area of Michigan covers thirteen counties, in only two (Jackson and Shiawassee) has it been mined commercially. The amount taken out at country banks in 1889 was 1,947 short tons, and the estimated product from the same source in 1890 was 2,000 short tons. The coal beds in Jackson and Shiawassee counties are from 2½ to 3½ feet in thickness, and have been described in previous volumes of Mineral Resources.

Product of coal in Michigan in 1889 and 1890.

Distribution.	1889.	1890.
	Short tons.	*Short tons.*
Loaded at the mines for shipment	53,104	57,100
Sold to local trade and used by employés	9,110	a12,885
Used at the mines for steam	5,217	4,992
Total	67,431	74,977
Total value	$115,011	$149,195

a Includes product from country banks.

Following is the annual product of coal in Michigan from 1877 to 1890. It will be seen that the State reached its highest producing point in 1882. Subsequent to that year, two companies which had an aggregate annual output of about 50,000 tons have reported no product:

Product of coal in Michigan from 1877 to 1890.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
Previous to 1877	350,000	1881	130,130	1886	60,434
1877	69,197	1882	135,339	1887	71,461
1878	85,322	1883	71,296	1888	81,407
1879	82,015	1884	36,712	1889	67,431
1880	129,053	1885	45,178	1890	74,977

MISSOURI.

Total product in 1889, 2,557,823 short tons; spot value, $3,479,057.

Total product in 1890, 2,735,221 short tons; spot value, $3,382,858.

The product of coal in Missouri for 1889 was 1,352,144 short tons less than the amount reported for 1888. This remarkable difference (about 33 per cent.) leads to the belief that the amount reported for 1888 was largely in excess of the actual product, though the mild winter of 1889-'90 probably would account for a portion of the decrease. The product of 1890 shows but a slight increase over that of 1889, which adds color to the belief in an exaggerated report for 1888.

There are thirty-five coal producing counties in the State, twenty of which produced coal commercially in 1890. The estimated product from country banks, of which there were 356 in operation in the census year, was 140,000 short tons.

The following tables show the amount of coal produced in Missouri in 1889 and 1890, by counties, with the distribution and value of the product:

Coal product of Missouri in 1889, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Total product of coal of all grades for year 1889.	Total amount received for coal sold in year 1889.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Adair	14,729	3,553	190	120	18,592	$30,860
Audrian	19,238	5,774	556	626	26,194	38,490
Barton	53,438	6,360	569	800	61,167	82,655
Bates	707,215	44,674	1,500	2,600	755,989	857,060
Boone	19,932	11,285	168	20	31,405	48,244
Caldwell	11,171	2,153		270	13,594	26,810
Callaway	2,004	13,242	728	79	16,053	28,727
Carroll		2,439			2,439	4,866
Cedar		2,070			2,070	4,137
Chariton		1,951	10		1,961	3,692
Cooper	670	326			996	2,574
Dade		6,708	52		6,760	11,385
Grundy	19,793	2,108		1,500	23,401	47,972
Henry	154,457	19,889	1,823	3,949	180,118	278,986
Howard	1,050		50		1,100	1,540
Jasper		720			720	1,340
Johnson	5,140	7,209	159	333	12,841	25,247
Lafayette	321,405	20,783	3,669	2,813	348,670	557,186
Linn		6,908	76	8	6,992	13,140
Livingstone		1,356	25		1,381	3,251
Macon	419,735	11,528	2,013	13,120	446,396	550,475
Montgomery	10,520	1,446	234	100	12,300	17,449
Monroe		222			222	345
Morgan	1,700	200	30	70	2,000	5,000
Nodaway		7,752	4	2	7,758	19,275
Putnam	74,913	6,741		2,120	83,774	112,089
Ralls		562			562	1,061
Randolph	162,365	53,287	2,002	3,809	221,463	285,019
Ray	210,635	5,786	1,929	2,180	220,530	351,153
St. Clair	4,085	2,570	125	100	6,880	14,885
Saline		2,225			2,225	4,861
Schuyler		770			770	1,013
Shelby		275			275	588
Sullivan		805			805	1,176
Vernon	32,650	5,910	500	360	39,420	46,506
Total	2,246,845	259,587	16,412	34,979	2,557,823	3,479,057

Coal product of Missouri in 1890 by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Audrian	12,800	7,161	300	20,261	$32,688	205	70
Barton	28,000	450	50	28,500	30,200	231	90
Bates	732,622	8,980	10,100	751,702	767,542	215	1,315
Boone	12,000	5,000		17,000	25,500	290	46
Caldwell	18,273	2,756	570	21,599	42,706	294	77
Callaway	480	4,827	24	5,331	7,996	218	11
Grundy, Linn, Putnam, and Adair	158,322	4,265	4,615	167,202	219,165	236	524
Henry	104,368	4,295	1,105	109,768	161,995	207	311
Johnson	5,910	40		5,950	8,030	183	15
Lafayette	330,740	13,812	3,136	347,688	589,402	217	1,056
Macon	516,683	4,630	18,748	540,061	600,373	259	1,027
Montgomery	500	12,940	144	13,584	18,393	200	33
Morgan	400	200	50	650	1,300	75	8
Randolph	250,376	16,156	2,840	269,372	306,736	229	635
Ray	259,466	14,685	3,967	278,118	422,074	241	687
St. Clair	5,050			5,050	7,575	140	27
Vernon	13,315	40	30	13,385	16,183	118	44
Small mines		140,000		140,000	175,000		
Total	2,449,305	240,237	45,679	2,735,221	3,382,858	(a) 229	5,971

a Average for the State.

Product of coal in Missouri from 1873 to 1890.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	784,000	1879	1,008,000	1885	3,080,000
1874	799,680	1880	1,680,000	1886	1,800,000
1875	840,000	1881	1,960,000	1887	3,209,916
1876	1,008,000	1882	2,240,000	1888	3,909,967
1877	1,008,000	1883	2,520,000	1889	2,557,823
1878	1,008,000	1884	2,800,000	1890	2,735,221

MONTANA.

Total product in 1889, 363,301 short tons; spot value, $880,773. Total product in 1890, 517,477 short tons; spot value, $1,252,492.

Coal mining in Montana seems to have experienced a remarkable impetus in the last two years, the product for 1889 being 321,834 short tons greater than, or nearly nine times as much as, in 1888. The product for 1890 shows a further increase of 154,176 short tons. The value, however, is not so much in proportion, the price realized per ton falling from $3.50 in 1888 to $2.42 in 1889 and 1890. A full description of the coal mines of Montana and their operations was published in Mineral Resources for 1888, and a number of analyses of the Montana coals were given in the volume for 1885.

Coal product of Montana in 1889, by counties.

Counties.	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.	Total product of coal of all grades for year 1889.	Total amount received for coal sold in year 1889.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Cascade	161,687	4,723	70			166,480	$339,226
Choteau		670	100	50		820	2,160
Custer		3,450	10	10		3,470	9,129
Dawson		733				733	1,900
Fergus		415	45			460	1,380
Gallatin	42,745		329	764		43,838	104,877
Lewis and Clarke		50				50	200
Missoula		150				150	450
Park	109,940	564	1,608	4,612	30,576	147,300	421,950
Total	314,372	10,755	2,162	5,436	30,576	363,301	880,773

Coal product of Montana in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Cascade	193,919	6,516			200,435	$406,748	379
Choteau	200	600			800	2,000	6
Custer		10,228			10,228	26,417	27
Dawson	100	350			450	1,350	3
Fergus		1,230	30		1,260	5,740	8
Gallatin	50,062	386	1,004		51,452	119,084	120
Lewis and Clarke	10	105			115	283	8
Park	221,725	4,012	3,000	24,000	252,737	690,870	705
Total	466,016	23,427	4,034	24,000	517,477	1,252,492	1,251

Product of coal in Montana from 1883 to 1889.

Years.	Short tons.	Years.	Short tons.
1883	19,795	1887	10,202
1884	80,376	1888	41,467
1885	86,440	1889	363,301
1886	49,846	1890	517,477

The following notes and statements of the production by counties have been prepared by Mr. F. F. Chisolm, special agent of the Geological Survey at Denver.

Beaver Head county.—No mining was carried on in Beaver Head county in 1890. The coal, as stated in previous volumes of Mineral Resources, is found on Medicine Lodge and Horse Prairie creeks and is of an inferior lignite.

Cascade county.—There were seven mines producing coal in Cascade county in 1890 and four mines that were non-producers. The producing mines were the Castner, Sand Coulee, Cora M. Ross, Mann, Powell & Heerman, Paul and Dean. By far the most important producer in 1890 was the Sand Coulee, which had an output of 194,505 tons. The seven mines employed an aggregate of 379 men. At six of these the average wages paid miners was $3.00 per day, while one reported $3.50 as the average rate per day.

Analyses of coals and charcoal from the Sand Coulee, Montana.

	Coking coal.	Dry coal.	Charcoal.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	3.98	2.81	2.25	3.01
Volatile matter	33.15	29.43	25.10	30.23
Fixed carbon	57.05	56.50	65.60	59.71
Ash	5.83	11.27	7.05	7.05
Total	100.01	100.01	100.00	100.00

Choteau county.—Only one productive mine reports from Choteau county in 1890, the two other mines in the county having no output. The producing mine, the O'Hanlon, employed 6 men, and paid an average of $3 per day to miners.

Custer county.—Two mines in Custer county, produced an aggregate of 10,228 tons, all of which was consumed locally. The mines gave employment to 27 men.

Dawson county.—A small amount of coal (450 short tons) was mined in 1890, to supply the wants of ranchmen and the small local trade of the section.

Deer Lodge county.—Some coal has been discovered in Deer Lodge county, but the coal veins are very narrow and bony, and no attempt has been made to produce coal for market. So far no vein which could be profitably worked has been discovered.

Fergus county.—The product in 1890 was 1,260 short tons, all of which was sold to local trade and used about the mine. Two mines were not producing.

Gallatin county.—The Timberline mine produced 51,451 short tons in 1890. Analyses of this coal have been published in previous volumes.

Lewis and Clarke county.—In Lewis and Clarke county, from two small openings, one near Hogan and the other at Dearborn, a little coal was produced in 1890 for the local trade at these mines. In addition to this production a trifling amount of coal was probably dug by individuals for their own use from coal openings on Sun River, above Fort Shaw; around the base of the Haystack Butte, near Eagle Rock; and also a little north of the Mullan Pass.

Meagher county.—Lack of railway facilities has prevented the development of the coal veins outcropping at various points in Meagher county, and the value of the coal has not been fully determined. The coal field is the extension south of the Sand Coulee field and the coal is probably similar in character to that of Cascade county.

Park county.—The total product of Park county in 1890 was 252,437 short tons. The only coke made in the State is from the Cokedale mine, in this county. The amount of coal made into coke in 1890 is reported at 24,000 short tons. Three mines, the Rocky Fork, Bryan, and Cokedale, were producers in 1890 and employed 705 men, who received from $3 to $3.50 per day.

Analyses of coal from Rocky Fork and Bryan mines.

	Rocky Fork.	Bryan.
	Per cent.	*Per cent.*
Water	2.50	9.5
Volatile matter	46.12	34.0
Fixed carbon	46.20	54.0
Ash	6.01	2.5
Total	100.83	100.0

Silverbow county.—A number of coal openings have been made in Silverbow county, but there was no production in 1890. The principal developments are on the mines of the Mullan Pass Coal Company, at Blossburg, but the property has not been worked since 1886.

Yellowstone county.—While coal veins outcrop at a great number of points in Yellowstone county, no extensive mining has yet been carried on. The coal found in this county is almost all lignite, similar to that found in the eastern portion of Montana, and not desirable for locomotive use. The only coal mined in the county was to supply the local trade at various small points and for the use of ranchmen.

Montana coal mines not operated in 1890.

Counties.	Mines.	Location.	Counties.	Mines.	Location.
Beaverhead	**Red Rock**	**Beaver Head.**	**Deerlodge**	**Taylor**	**Drummond.**
Do	Horse Prairie.	Red Rock.	Do	Keith	Do.
Cascade	Largent	Sand Coulee.	Fergus	Viall	Wolf Creek.
Do	Great Falls	Truly.	Do	Post Quartermasters.	Maginnis Reservation.
Do	Bickett	Smith River.			
Do	Brown	Belt.	Lewis and Clarke	Gillett mine	Hogan.
Choteau	Swigerts	Birch Creek.	Do	Walker mine	Do.
Do	Fort Assinniboine.	Fort Assinniboine.	Missoula	Missoula	Missoula.
			Park	Nevenhuisen	Livingston.
Deerlodge	New Chicago	Drummond.	Yellowstone	Northern Pacific Coal Co.	North of Billings.
Do	Beiber	Do.			
Do	Mullan Pass	Blossburg.	Do	F. Billings	Do.
Do	Featherman	Drummond.			

NEBRASKA.

Total product in 1889, 1,400 short tons; spot value, $4,900. Total product in 1890, 1,500 short tons; spot value, $4,500.

The small product of Nebraska comes from one mine in Pawnee county. The coal, which is all consumed locally, is mined irregularly by farmers in odd seasons. A description of the Nebraska coal seams, by Prof. L. E. Hicks, of the University of Nebraska, was published in Mineral Resources for 1887.

NEW MEXICO.

Total product in 1889, 486,943 short tons; spot value, $872,628. Total product in 1890, 375,777 short tons; spot value, $504,390.

The product of coal in New Mexico in 1889 was 139,722 short tons less than in 1888, while the value of the product decreased $1,003,367, showing that the tonnage reported for 1888 was evidently not only excessive, but that the valuation placed upon it was far more than the amount actually realized. The product for 1890 shows a further decrease of 111,166 short tons in tonnage and of $368,238 in value.

The following tables show the amount and value of the coal mined in New Mexico in 1889 and 1890, by counties, with the distribution of the product:

Coal product of New Mexico in 1889, by counties.

Counties.	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.	Total product of coal of all grades for year 1889.	Total amount received for coal sold in year 1889.	Average price of coal on cars at the mines.
	Sh'rt tons.	*Sh'rt tons.*	*Sh'rt tons.*	*Sh'rt tons.*	*Sh'rt tons.*	*Sh'rt tons.*		
Bernalillo	229, 298	446	1, 242	2, 073	....	233, 059	$395, 892	$1. 70
Colfax	145, 660	2, 050	554	3, 200	....	151, 464	201, 027	1. 33
Lincoln	....	1, 255	....	....	....	1, 255	3, 138	2. 50
Rio Arriba	13, 150	....	200	300	....	13, 650	24, 843	1. 82
San Juan	....	385	15	....	....	400	1, 055	2. 64
Santa Fe	26, 505	1, 085	470	810	6, 000	34, 870	74, 666	2. 14
Sierra	39	....	1	....	....	40	200	5. 00
Socorro	51, 905	200	100	....	....	52, 205	171, 807	3. 29
Total	466, 557	5, 421	2, 582	6, 383	6, 000	486, 943	872, 628	1. 79

Coal product of New Mexico in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average number employed
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*		
Bernalillo	180,162	480	1,005	181,647	$207,948	375
Colfax	145,000	2,400	4,000	151,400	198,500	360
Lincoln	....	655	520	1,175	5,415	11
Rio Arriba	11,900	75	200	12,175	21,000	20
San Juan	....	510	....	510	1,137	4
Santa Fe	21,270	1,140	360	22,770	52,190	55
Sierra	....	100	....	100	200	2
Small mines	....	6,000	....	6,000	18,000	....
Total	358,332	11,360	6,085	375,777	504,390	827

Bernalillo county—The output of 181,647 short tons represents the product of five mines, which gave employment to 375 men. The average wages paid miners was $2.62. Two mines in the county were not operated during the year.

Colfax county.—Two new mines, the Sproule and Willoughby, began production in 1890 to supply a small local demand in the vicinity of Raton, but the output was inconsiderable, and as in the past nearly the entire output comes from the Raton Coal and Coking Company's mines in Bloss cañon, which have been fully described in previous volumes of the "Mineral Resources." The county produced 151,400 tons and gave employment to 360 men.

Rio Arriba county.—The only production in Rio Arriba county is by the Monero Coal and Coke Company, operating the Monero and Grand Mesa mines, located at Monero, on the line of the Denver and Rio Grande railway. All of the product except that used at the mine is sold in Colorado, chiefly for fuel to the local railway.

Lincoln county.—The coal fields of Lincoln county occur near White Oaks and Nogal, far from railway transportation, and the production is limited to the demands of the local trade, nearly half of the total production being used for steam by the owners of the principal mine, the Parker, near White Oaks. The coal deposits of this section are more or less metamorphosed through the influence of the eruptive outflows common in this portion of New Mexico. The composition of the coal from the Parker mine and Cochran mine, both near White Oaks, is indicated by the following average analysis:

Average analysis of coal from the Parker and Cochran mines.

	Per cent.
Water	2.35
Volatile matter	35.53
Fixed carbon	50.24
Ash	11.88
Total	100.00
Sulphur	0.61

In thickness the seams vary from 2 to 5 feet.

During 1890 some twenty coal filings were made near Lincoln, and coal of good quality exposed in nearly every case.

San Juan and Sierra counties.—The total product of the two counties in 1890 was only 610 short tons, which was used locally.

Santa Fé county.—The product of six mines in 1890 was 22,770 short tons. These mines employed an average of 55 men, who received $3 per day. The following analysis has been made of the coal from the Sterling mine in Santa Fé county:

Analysis of coal from the Sterling mine.

	Per cent.
Water	2.31
Volatile matter	50.45
Fixed carbon	41.55
Ash	5.69
Total	100.00
Sulphur	1.97

New Mexico coal mines not operated in 1890.

Counties.	Mines.	Location.
Bernalillo	Puercos Valley	Gallup.
Do	Cleveland	Tijeras Cañon.
Lincoln	Cochran	White Oaks.
Socorro	Bartlett	Magdalena.

Coal product of New Mexico from 1882 to 1890.

Years.	Short tons.	Years.	Short tons.
1882	157,092	1887	508,034
1883	211,347	1888	626,665
1884	220,557	1889	486,943
1885	306,202	1890	375,777
1886	271,285		

The various coal mines of the Territory have been more fully described in past volumes of Mineral Resources, and the following index will give the pages and volumes:

Description of New Mexico coal fields in previous reports.

[Years and pages of Mineral Resources.]

Localities.	1882.	1883-4.	1885.	1886.	1887.
	Page.	*Page.*	*Page.*	*Page.*	*Page.*
Raton	62	57-58	....	....	278
Cerrillos	63	....	....	....	279
Gallup	63	....	....	....	279
Monero	63	....	....	....	279
San Pedro	64	170	....	....	278

NORTH CAROLINA.

Total product in 1889, 192 short tons; spot value, $451. Total product in 1890, 10,262 short tons; spot value, $17,864.

Coal mining in North Carolina did not begin until 1889, and can hardly be said to have assumed commercial importance until the next year. The production is limited to Chatham county and but one company is operating. The coal areas of the State have been described in Mineral Resources for 1885 and 1887. The value and distribution of the product for 1889 and 1890 is shown in the following table:

Coal product of North Carolina in 1889 and 1890.

Distribution.	1889.	1890.
	Short tons.	*Short tons.*
Loaded at mines for shipment	190	9,262
Sold to local trade and used by employés	1	100
Used for steam at the mine	1	900
Total	192	10,262
Total value	$451	$17,864

NORTH DAKOTA.

Total product in 1889, 28,907 short tons; spot value, $41,431. Total product in 1890, 30,000 short tons; spot value, $42,000.

The Eleventh Census gives the first report of coal mining in North Dakota, the product for that year being 28,907 short tons. There were five commercial mines operating in the census year whose total product was 24,982 short tons. The number of small banks was 337, whose entire output amounted to 3,925 short tons, or an average of a little less than 12 tons each. The coal-producing counties are Morton, Stark and Ward, the first two being in the southwestern and the last mentioned in the north central portion of the State. Previous to 1889 the product has been reported for the Territory of Dakota, but as the producing region of the Territory is contained in what is now the State of North Dakota, the product for previous years may be included in the following table:

Coal product of North Dakota from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	35,000	1888	34,000
1885	25,000	1889	28,907
1886	25,955	1890	30,000
1887	21,470		

The limited production of coal in North Dakota is due to the fact that it is an inferior quality of lignite, and not only is it a poor fuel, but the cost of mining is comparatively high, and consumers find it more economical to use coal brought from other States.

OHIO.

Total product in 1889, 9,976,787 short tons; spot value, $9,355,400. Total product in 1890, 11,494,506 short tons; spot value, $10,783,171.

The product of coal in Ohio in 1889 was nearly 1,000,000 tons less than that of the preceding year, showing the effect of the mild winter previously noted. In 1890 the production increased 1,517,719 short tons over that of 1889, and reached the highest point in the history of the State.

The following tables show the product for the two years, with the value and distribution:

Coal product in Ohio in 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.	Total employés about mines.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.			
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*		
Athens	1,102,670	70,933	4,273	7,288	39,022	1,224,186	$994,344	2,228
Belmont	456,221	175,396	3,299	1,946	5,000	641,862	558,333	1,100
Carroll	337,393	14,101	88	200	....	351,782	261,813	565
Columbiana	542,665	49,388	2,492	2,279	....	596,824	471,945	955
Coshocton	112,130	53,691	446	332	....	166,599	163,659	290
Gallia	14,339	7,658	1,211	....	....	23,208	24,068	34
Guernsey	328,568	26,552	3,112	3,936	....	362,168	313,480	668
Harrison	800	31,817	1,107	....	....	33,724	41,028	8
Hocking	820,294	10,757	523	13,475	....	845,049	683,551	1,187
Holmes	....	9,272	146	5	....	9,423	13,037	....
Jackson	823,269	94,241	3,009	6,355	....	926,874	953,696	2,251
Jefferson	173,260	90,287	3,068	2,268	2,947	271,830	273,075	511
Lawrence	44,432	57,872	352	....	....	102,656	106,269	232
Mahoning	187,321	23,227	2,798	4,717	22,500	240,563	280,406	636
Medina	125,759	2,975	1,385	5,942	....	136,061	158,003	379
Meigs	103,301	111,698	3,132	2,146	....	220,277	223,614	567
Monroe	16,000	4,246	479	....	....	20,725	34,066	29
Morgan	....	7,662	398	....	....	8,060	10,502	....
Muskingum	133,589	79,254	554	608	....	214,005	212,873	304
Noble	10,200	26,250	1,950	....	....	38,400	44,039	43
Perry	1,506,282	51,313	3,754	4,437	....	1,565,786	1,317,963	3,056
Portage	73,728	2,641	598	1,150	....	78,117	99,213	179
Stark	782,466	41,541	5,502	22,485	....	851,994	1,073,703	1,975
Summit	36,152	11,645	857	2,072	....	50,726	92,723	170
Trumbull	101,270	4,193	1,417	1,240	....	108,120	176,934	388
Tuscarawas	562,060	113,886	2,468	5,091	....	683,505	544,524	1,061
Vinton	85,202	14,756	1,262	820	....	102,040	104,972	256
Washington	11,374	6,270	341	60	....	18,045	19,684	23
Wayne	75,478	3,350	250	5,100	....	84,178	103,883	248
Total	8,566,223	1,196,872	50,271	93,952	69,469	9,976,787	9,355,400	19,343

Coal product of Ohio in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Athens	1, 152, 825	29, 551	6, 499	16, 580	1, 205, 455	$999, 003	198	2, 122
Belmont	684, 063	82, 185	1, 862	6, 000	774, 110	605, 604	201	1, 401
Carroll	328, 467	400	100	....	328, 967	278, 704	188	642
Columbiana	545, 014	17, 818	4, 763	....	567, 595	518, 136	219	987
Coshocton	172, 500	5, 000	200	....	177, 700	159, 150	237	327
Gallia	16, 176	336	....	....	16, 512	14, 903	205	33
Guernsey	408, 084	2, 770	2, 885	....	413, 739	282, 355	225	788
Jackson	882, 243	77, 947	10, 688	....	970, 878	974, 892	180	2, 654
Jefferson	373, 012	114, 429	2, 552	1, 179	491, 172	409, 654	203	944
Harrison	2, 000	6, 600	....	....	8, 600	12, 900	268	14
Hocking	1, 258, 722	8, 500	52, 205	....	1, 319, 427	1, 084, 057	240	1, 625
Lawrence	75, 989	1, 015	....	....	77, 004	83, 265	198	242
Mahoning	235, 474	18, 615	2, 230	....	256, 319	306, 633	220	537
Medina	130, 359	5, 683	3, 700	....	139, 742	167, 538	219	310
Meigs	134, 042	119, 787	1, 536	....	255, 365	316, 247	202	616
Monroe	....	1, 000	....	....	1, 000	1, 000	100	3
Muskingum	197, 113	32, 406	200	....	229, 719	197, 640	250	366
Noble	5, 640	1, 210	....	....	6, 850	7, 350	102	25
Perry	1, 880, 502	39, 176	1, 739	....	1, 921, 417	1, 642, 967	188	2, 977
Portage	68, 338	1, 328	1, 000	....	70, 666	112 475	236	155
Stark	767, 703	28, 174	40, 572	....	836, 449	1, 088, 978	182	1, 930
Summit	101, 602	5, 614	5, 781	....	112, 997	169, 171	173	389
Trumbull	46, 652	362	700	....	47, 714	57, 713	243	102
Tuscarawas	576, 413	12, 015	1, 447	....	589, 875	499, 685	196	1, 082
Vinton	78, 546	1, 495	675	....	80, 716	86, 611	241	186
Washington	4, 990	1, 000	....	....	5, 990	5, 281	91	32
Wayne	35, 418	460	2, 650	....	38, 528	41, 259	178	87
Small mines	....	550, 000	....	....	550, 000	660, 000	....	....
Total	10, 161, 887	1, 164, 876	143, 984	23, 759	11, 494, 506	10, 783, 171	(*a*) 201	20, 576

a Average for the State.

In collecting the statistics for 1889 and 1890 no attempt has been made to segregate the nut and slack coal from the lump, coal of all grades (except waste slack) being included in the total. From the State mine inspectors' reports the following statement has been compiled, showing the amount of lump and nut coal produced in 1886 and the lump, nut, pea, and slack produced in 1887 and 1888. The report for 1887 was prepared by Mr. Thomas B. Bancroft, and that for 1888 by Mr. R. M. Hazeltine, State mine inspector.

Coal produced in Ohio, by counties, in 1886, 1887, and 1888.

Counties.	1886.			1887.				1888.			
	Lump.	Nut.	Total.	Lump.	Nut.	Pea and slack.	Total.	Lump.	Nut.	Pea and slack.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	766,411	132,635	899,046	884,622	141,900	57,021	1,083,543	1,081,559	167,181	87,958	1,336,698
Belmont	462,252	111,527	573,779	494,974	108,363	118,430	721,767	735,054	182,264	190,788	1,108,106
Columbiana	268,465	67,598	336,063	393,617	74,985	47,455	516,057	314,034	90,575	61,582	466,191
Coshocton	43,361	9,573	52,934	88,367	17,412	19,012	124,791	114,051	24,476	29,376	167,903
Carroll	184,095	32,585	216,680	186,624	39,137	67,567	293,328	217.541	74,558	62,998	355,097
Guernsey	349,503	84,297	433,800	360,340	100,475	92,798	553,613	260,552	64,984	58,192	383,728
Gallia	14,862	2,562	17,424	13,000	....	2,365	15,365	13,571	....	3,151	16,722
Holmes	10,491	2,179	12,670	7,407	2,283	836	10,526	5,500	1,562	1,059	8,121
Hocking	637,224	104,347	741,571	693,097	116,914	43,052	853,063	881,706	162,050	42,782	1,086,538
Harrison	5,132	377	5,509	3,643	72	817	4,032	2,465	200	200	2,865
Jackson	717,516	139,224	856,740	863,047	194,888	76,770	1,134,705	827,854	174,726	86,181	1,088,761
Jefferson	442,051	33,615	475,666	222,277	40,328	31,270	293,875	171,138	31,605	40,435	243,178
Lawrence	139,173	27,760	166,933	113,790	22,272	7,497	143,559	114,757	21,243	1,806	137,806
Medina	223,747	28,664	252,411	178,772	30,425	16,290	225,487	143,781	18,976	35,695	198,452
Meigs	165,627	26,636	192,263	153,444	23,051	8,710	185,205	170,280	48,773	23,430	242,483
Muskingum	85,011	11,590	96,601	127,353	9,442	35,133	171,928	148,782	17,890	45,189	211,861
Mahoning	251,515	61,525	313,040	210,294	18,999	43,056	272,349	177,477	11,775	41,733	231,085
Morgan	4,370	....	4,370	3,500	....	600	4,100	....	....	....	....
Noble	3,342	....	3,342	4,000	1,820	1,000	6,820	4,000	1,200	1,000	6,200
Perry	1,346,131	261,535	1,607,666	1,535,911	179,414	155,515	1,870,840	1,430,268	229,933	76,604	1,736,805
Portage	61,273	9,066	70,339	48,649	4,442	12,072	65,163	52,488	8,246	10,189	70,923
Scioto	....	....	....	....	....	....	....	....	....	....	....
Stark	519,992	73,430	593,422	586,014	81,973	116,177	784,164	590,009	74,782	128,436	793,227
Summit	70,221	12,004	82,225	76,110	5,700	14,005	95,815	90,050	4,373	17,601	112,024
Tuscarawas	212,362	55,304	267,666	363,004	81,554	61,908	506,466	418,860	112,314	14,943	546,117
Trumbull	162,331	26,200	188,531	132,829	27,058	8,102	167,989	120,875	12,707	24,744	157,826
Vinton	49,392	10,621	60,013	69,043	11,702	8,982	89,727	84,706	12,701	11,288	108,695
Wayne	99,174	9,883	109,057	84,906	8,436	11,808	105,150	69,825	9,498	11,834	91,157
Washington	4,000	1,500	5,500	1,480	400	....	1,880	1,462	115	855	2,432
Total	7,299,024	1,386,187	8,685,211	7,900,204	1,342,945	1,057,658	10,300,807	8,241,145	1,558,707	1,111,099	10,910,951

The following table shows the annual increase and decrease in production by counties from 1886 to 1890:

Comparative statistics by counties in Ohio from 1886 to 1890.

Counties.	1887 compared with 1886.		1888 compared with 1887.		1889 compared with 1888 (*a*).		1890 compared with 1889 (*b*).	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	184,497		253,155			112,512		18,731
Belmont	147,988		386,339			406,244	132,248	
Carroll	76,698		61,784			3,315		22,815
Columbiana	179,994			49,866	130,633			29,229
Coshocton	71,857		43,112			1,304	11,101	
Gallia		2,059	1,357		6,486			6,696
Guernsey	119,813			169,885		21,560	51,571	
Harrison		1,477		1,167	30,859			25,124
Hocking	111,492		233,475			241,459	474,378	
Holmes		2,144		2,405	1,302			(*c*)9,423
Jackson	278,865			45,944		161,887	44,004	
Jefferson	18,209			50,697	28,652		219,342	
Lawrence		23,374		5,753		35,150		25,652
Mahoning		40,691		41,314	9,528		15,756	
Medina		26,924		27,035		62,391	3,681	
Meigs		7,058	57,278			22,206	35,088	
Monroe					(*d*)20,725			19,725
Morgan		270		4,100	(*d*)8,060			(*c*)8,060
Muskingum	75,327		89,933		2,144		15,714	
Noble	2,978			120	32,200			31,550
Perry	263,175			134,035		171,019	355,631	
Portage		5,176	5,760		7,194			7,451
Stark	190,742		9,063		58,767			15,545
Summit	13,590		16,209			61,298	62,271	
Trumbull		20,542		10,163		49,706		60,406
Tuscarawas	238,800		39.651		137,388			173,630
Vinton	29,714		18,968			6,655		21,324
Washington		3,620	552		15,613			12,055
Wayne		3,907		13,933		6,979		45,650
Totals	2,003,739	137,242	1,166,636	556,477	489,551	1,423,715	1,420,785	533,066
Net increase or decrease	1,866,497		610,159			934,164	887,719	

a Includes product of small banks in 1889 and not in 1888.
b Includes product of small banks in 1889 and not in 1890.
c Product of small banks in 1889 not enumerated in 1890.
d Entire product of 1889; no product reported in 1888.

There are twenty-nine counties in the State which produced coal in 1889, though in two of them, Holmes and Morgan, the entire product was from small banks, and these are excluded from the tabulated statement for 1890. The total number of small banks in Ohio, as reported by the Census Office, is 1,745, which produced, in 1889, 506,049 short tons of coal. The counties showing increased production in 1889 over that of 1888 were Columbiana, Gallia, Harrison, Holmes, Jefferson, Mahoning, Monroe (*), Morgan (*), Muskingum, Noble, Portage, Stark, Tuscarawas, and Washington. The counties having a decreased product were Athens, Belmont, Carroll, Coshocton, Guernsey, Hocking, Jackson, Lawrence, Medina, Meigs, Perry, Summit, Trumbull, Vinton, and Wayne. The counties having an increased production in 1890 over 1889 were Belmont, Coshocton, Guernsey, Hocking, Jackson, Jefferson, Mahoning, Medina, Meigs, Muskingum, Perry, and Summit. The most notable increases were in Hocking and Perry counties, that in the former county being 474,378 short tons, and in the latter 355,631 short tons. The counties having a decreased production were Athens, Carroll, Columbiana, Gallia, Harrison, Lawrence, Monroe, Noble, Portage, Stark, Trumbull, Tuscarawas, Vinton, Washington, and Wayne.

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* No product reported in 1888.

The coal-producing portions of the State of Ohio are, for convenience of description, divided into twelve districts. The names of these districts, the counties or parts of counties embraced by them, and the amount of coal produced in each (exclusive of the product of small banks) for 1889 and 1890, are shown in the following table:

Coal product of Ohio in 1889 and 1890, by districts.

Names of districts.	Counties embraced in the districts.	Product in 1889.	Product in 1890.	Increase.	Decrease.
		Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Jackson	Jackson	922,631	970,878	48,247	
Ohio Valley	Lawrence, Gallia, Meigs, Monroe, Belmont, Jefferson, and Medina.	1,292,469	1,754,905	462,436	
Hocking Valley	Vinton, Hocking, Athens, and part of Perry.	3,089,525	3,705,464	615,939	
Cambridge	Guernsey	336,840	413,739	76,899	
Macksburg	Washington and Noble	23,982	12,840		11,142
Carrollton Valley	Harrison	4,200	8,600	4,400	
Muskingum Valley	Part of Perry, and Muskingum.	756,859	1,051,270	294,411	
Tuscarawas Valley	Coshocton, Tuscarawas, Stark, Summit, and Wayne.	1,738,387	1,675,549		62,838
Salineville	Columbiana	562,230	567,595	5,365	
Carrollton Valley	Carroll	337,583	328,967		8,616
Mahoning Valley	Mahoning and Trumbull	327,915	304,033		23,882
Palmyra	Portage	78,117	70,666		7,451
Total		9,470,738	10,864,506	1,507,697	113,929
Increase of product of commercial mines.			1,393,768	1,393,768	

The Hocking Valley is the most important producing district in the State, the product for 1890 being nearly one-third the entire product of the State. The following table shows the annual output of the Hocking Valley district for the past nine years:

Product of the Hocking Valley district from 1882 to 1890.

Years.	Short tons.	Years.	Short tons.
1882	1,812,833	1887	3,348,547
1883	1,916,355	1888	3,484,354
1884	2,725,000	1889	3,089,525
1885	2,894,660	1890	3,705,464
1886	2,960,000		

Annual coal product of Ohio from 1872 to 1890.

Years.	Short tons.	Years.	Short tons.
1872	5,315,294	1882	9,450,000
1873	4,550,028	1883	8,229,429
1874	3,267,585	1884	7,640,062
1875	4,864,259	1885	7,816,179
1876	3,500,000	1886	8,435,211
1877	5,250,000	1887	10,301,708
1878	5,500,000	1888	10,147,180
1879	6,000,000	1889	9,470,738
1880	7,000,000	1890	11,414,506
1881	8,225,000		

The following tables, compiled by Mr. Sidney D. Maxwell, superintendent of the Cincinnati Chamber of Commerce, exhibit interesting statistics of the coal trade of southern Ohio for a number of years:

Receipts of coal at Cincinnati for nineteen years.

Years.	Pittsburg (Youghiogheny).	Kanawha.	Ohio river.	Canal.	Anthracite.	Other kinds.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
1871-'72	19,254,716	....	a10,359,906	1,104,003	72,171	....	30,790,796
1872-'73	24,962,378	....	a11,075,072	1,162,052	75,000	....	37,274,497
1873-'74	24,014,681	....	a10,398,153	710,000	112,000	....	35,234,834
1874-'75	24,225,002	4,476,619	4,277,327	565,352	248,750	1,597,260	35,390,310
1875-'76	27,017,592	6,004,675	4,400,792	409,358	282,578	2,068,322	40,183,317
1876-'77	28,237,572	3,631,823	5,141,150	322,171	376,125	1,913,793	39,622,684
1877-'78	26,743,055	6,386,623	3,288,008	880,768	439,350	1,654,425	38,892,229
1878-'79	20,769,027	6,134,039	4,068,452	333,549	768,750	2,136,850	34,210,667
1879-'80	31,750,968	8,912,801	4,268,214	202,489	712,075	2,351,699	48,198,246
1880-'81	23,202,084	10,715,459	3,151,934	67,684	770,525	2,336,752	40,244,438
1881-'82	37,807,961	13,950,802	3,560,881	77,336	779,925	3,090,715	59,267,620
1882-'83	33,895,064	13,260,347	3,309,534	180,621	977,250	2,997,216	54,620,032
1883-'84	32,239,473	15,926,743	2,956,688	293,010	1,085,350	3,910,795	56,412,059
1884-'85	32,286,133	14,588,573	3,007,078	314,774	1,257,900	2,683,864	54,138,322
1885-'86	34,933,542	17,329,349	939,746	205,717	1,287,925	2,720,250	57,416,529
1886-'87	37,701,094	20,167,875	338,435	129,503	1,314,775	3,693,850	63,345,532
1887-'88	41,180,713	20,926,596	1,533,358	26,098	1,328,225	5,710,649	70,705,639
1888-'89	36,677,974	23,761,853	544,940	12,129	1,020,525	3,075,000	65,092,421
1889-'90	42,601,615	19,221,196	454,385	....	1,001,175	4,709,775	67,988,146

a Including Kanawha coal.

OREGON.

Total product in 1889, 64,359 short tons; spot value, $163,650. Total product in 1890, 61,514 short tons; spot value, $177,875.

The product of coal in Oregon continues to come principally from one mine, the output from other sources in 1889 being only 56 tons, and no account of this small factor has been taken in the product reported for 1890. The one commercial property is located at Marchfield, in Coos county, and the bulk of the product is shipped to San Francisco. The average price received for coal in 1888 was $3 per ton. In 1889 the price fell to $2.60 per ton, and rose again in 1890 to $2.89. The number of men employed in 1888 and 1889 was 160. The number reported for 1890 was 208, the increase probably being due to extended development work, looking to an increased production in the near future.

Amount, value, and distribution of the coal product of Oregon in 1889 and 1890.

Distribution.	1889.	1890.
	Short tons.	*Short tons.*
Loaded at mines for shipment	62,483	58,821
Sold to local trade and used by employés	1,316	1,936
Used at mines for steam and heat	560	757
Total	64,359	61,514
Total value	$163,650	$177,875

The coal is classed as a lignite, but is said to be similar in appearance to the bituminous coals of the Mississippi Valley. It will not coke, but serves very well for domestic purposes, and is also good for blacksmithing use. No authentic statistics of coal mining in Oregon have been obtained prior to 1886. In 1885 it was stated that the product probably did not exceed 50,000 short tons, and though that figure is undoubtedly excessive, it is quoted as the product for that year in the following table:

Coal product of Oregon from 1885 to 1890.

Years.	Short tons.	Years.	Short tons.
1885	50,000	1888	75,000
1886	45,000	1889	64,359
1887	31,696	1890	61,514

PENNSYLVANIA.

The total product in 1889, including coal shipped, the output of small banks, the coal sold by regular establishments to local trade and employés, and the amount consumed at the collieries for steam and heat was 81,719,059 short tons; spot value, $93,671,480. Total product in 1890, 88,770,814 short tons; spot value, $101,760,688.

Anthracite: Total product in 1889, 40,665,152 long tons, or 45,544,970 short tons; spot value, $65,718,165. Total product in 1890, 41,489,858 long tons, or 46,468,641 short tons; spot value, $66,383,772.

Bituminous: Total product in 1889, 36,174,089 short tons; spot value, $27,953,315. Total product in 1890, 42,302,173 short tons; spot value, $35,376,916.

ANTHRACITE.

[By John H. Jones.]

Total product in 1889, 40,665,152 long tons (equivalent to 45,544,970 short tons); spot value, $65,718,165. Total product in 1890, 41,489,858 long tons (equivalent to 46,468,641 short tons); spot value, $66,383,772.

The total production of anthracite coal in Pennsylvania during the calendar year 1889 was 40,665,152 tons of 2,240 pounds (equal to 45,544,970 tons of 2,000 pounds). The marketable product, that is, the amount of coal shipped and sold to local trade and employés, was 37,146,456 long tons (or 41,604,031 short tons), valued at the mines at $65,718,165, or an average of 1.76\frac{2}{10}$ per long ton. The quantity reported by the transportation companies as actually carried to market, which is the usual basis for statistics of shipments, was 35,407,710 tons during the year 1889; 1,329,580 tons were used by employés and sold to local trade in the vicinity of the mines, and 3,518,696 tons were reported as consumed for steam and heating purposes in and about the mines. For reasons stated below the item of colliery consumption is excluded from the valuation of the product.

The total production of anthracite coal in Pennsylvania during the calendar year 1890 was 41,489,858 long tons (or 46,468,641 short tons), of which the marketed amount was 38,403,552 long tons (or 43,011,978 short tons), valued at the mines at $66,383,772, or an average of 1.72\frac{2}{10}$ per long ton. The total quantity loaded on cars and sent to market was 36,617,042 tons during the year 1890; 1,786,510 tons were used by employés and sold to local trade in the vicinity of the mines, and 3,086,306 tons were consumed for steam and heat in and about the mines. The item of colliery consumption is, however, somewhat indefinite, the coal being taken either from the current mining or from screenings, and used where needed, often without preparation, and rarely included in the accounts of the operator, being reported in most instances as "approximated." For these reasons it has been excluded from the basis of valuation of the product at the mines. The average number of days worked during the year 1890 was 200. The number of persons employed during the year, including superintendents, engineers, and clerical force, was 126,000. The total number of regular establishments or breakers equipped for the preparation and shipment of coal was 350, exclusive of small diggings and washeries supplying local trade.

The average number of days worked during the year 1889 by all collieries was 194. The suspension of mining, during periods aggregating about one-third of the year, was caused mainly by the inability of the market to absorb a larger product. The number of persons employed during the year, including superintendents, engineers, and clerical force, was 125,229. The total amount paid in wages to all classes during the year was $39,152,124. The total number of regular establishments or breakers equipped for the preparation and shipment of coal was 342, 19 of which were idle during the year. Besides these, there were 49 small diggings and washeries, supplying local trade. There were also 18 new establishments in course of construction.

Comparing the statistics of anthracite coal production in 1889 and 1890, it will be seen that there was a gain in product during the latter year of 824,706 long tons (equal to 923,671 short tons) and an increase in value of $665,607, the average price per ton realized at the mines during each year being $\$1.76\frac{2}{10}$ and $\$1.72\frac{2}{10}$, respectively. The average number of days worked during 1890 was 200, as against 194 days in 1889. The total number of employés at anthracite mines in 1889 was 125,229 and in 1890, 126,000. The number of regular establishments increased from 342 in 1889 to 350 in 1890.

The anthracite coal fields of Pennsylvania are situated in the eastern part of the State, and extend about equal distances north and south of a line drawn through the middle of the State from east to west, in the counties of Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, Sullivan, and Susquehanna, and known under three general divisions, viz: Wyoming, Lehigh and Schuylkill regions. Geologically they are divided into five well-defined fields or basins, which are again subdivided, for convenience of identification, into districts, as follows:

Geological fields or basins.	*Local districts.*	*Trade regions.*
Northern	Carbondale	Wyoming
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Western Northern	Bernice	
Eastern Middle	Green Mountain	Lehigh
	Black Creek	
	Hazleton	
	Beaver Meadow	
Southern	Panther Creek	
	East Schuylkill	Schuylkill
	West Schuylkill	
	Lorberry	
	Lykens Valley	
Western Middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The following table shows the annual shipments of anthracite coal from the Pennsylvania fields since 1820, with the percentages from each region:

Annual shipments of anthracite coal in Pennsylvania since 1820, with the number of tons and percentage shipped from each region.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*
1820	....	....	365		....	....	365
1821	....	....	1,073	....	....	....	1,073
1822	1,480	39.79	2,240	60.21	....	....	3,720
1823	1,128	16.23	5,823	83.77	....	....	6,951
1824	1,567	14.10	9,541	85.90	....	....	11,108
1825	6,500	18.60	28,393	81.40	....	....	34,893
1826	16,767	34.90	31,280	65.10	....	....	48,047
1827	31,360	49.44	32,074	50.56	....	....	63,434
1828	47,284	61.00	30,232	39.00	....	....	77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471
1853	2,665,110	51.30	1,054,309	20.29	1,475,732	28.41	5,195,151
1854	3,191,670	53.14	1,207,186	20.13	1,603,478	26.73	6,002,234
1855	3,552,943	53.77	1,284,113	19.43	1,771,511	26.80	6,608,567
1856	3,603,029	52.91	1,351,970	19.52	1,972,581	28.47	6,927,580
1857	3,373,797	50.77	1,318,541	19.84	1,952,603	29.39	6,644,941
1858	3,273,245	47.86	1,380,030	20.18	2,186,094	31.96	6,839,369
1859	3,448,708	44.16	1,628,311	20.86	2,731,236	34.98	7,808,255
1860	3,749,632	44.04	1,821,674	21.40	2,941,817	34.56	8,513,123
1861	3,160,747	39.74	1,738,377	21.85	3,055,140	38.41	7,954,264
1862	3,372,583	42.86	1,351,054	17.17	3,145,770	39.97	7,869,407
1863	3,911,683	40.90	1,894,713	19.80	3,759,610	39.30	9,566,006
1864	4,161,970	40.89	2,054,669	20.19	3,960,836	38.92	10,177,475
1865	4,356,959	45.14	2,040,913	21.14	3,254,519	33.72	9,652,391
1866	5,787,902	45.56	2,179,364	17.15	4,736,616	37.29	12,703,882
1867	5,161,671	39.74	2,502,054	19.27	5,325,000	40.99	12,988,725
1868	5,330,737	38.52	2,502,582	18.13	5,968,146	43.25	13,801,465
1869	5,775,138	41.66	1,949,673	14.06	6,141,369	44.28	13,866,180
1870	4,968,157	30.70	3,239,374	20.02	7,974,660	49.28	16,182,191
1871	6,552,772	41.74	2,235,707	14.24	6,911,242	44.02	15,699,721
1872	6,694,890	34.03	3,873,339	19.70	9,101,549	46.27	19,669,778
1873	7,212,601	33.97	3,705,596	17.46	10,309,755	48.57	21,227,952
1874	6,866,877	34.09	3,773,836	18.73	9,504,408	47.18	20,145,121
1875	6,281,712	31.87	2,834,605	14.38	10,596,155	53.75	19,712,472
1876	6,221,934	33.63	3,854,919	20.84	8,424,158	45.53	18,501,011
1877	8,195,042	39.35	4,332,760	20.80	8,300,377	39.85	20,828,179
1878	6,282,226	35.68	3,237,449	18.40	8,085,587	45.92	17,605,262
1879	8,960,829	34.28	4,595,567	17.58	12,586,293	48.14	26,142,689
1880	7,554,742	32.23	4,463,221	19.05	11,419,279	48.72	23,437,242
1881	9,253,958	32.46	5,294,676	18.58	13,951,383	48.96	28,500,017
1882	9,459,288	32.48	5,689,437	19.54	13,971,371	47.98	29,120,096
1883	10,074,726	31.69	6,113,809	19.23	15,604,492	49.08	31,793,027
1884	9,478,314	30.85	5,562,226	18.11	(*a*)15,677,753	51.04	30,718,293
1885	9,488,426	30.01	5,898,634	18.65	(*a*)16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	(*a*)17,031,826	52.82	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	(*a*)19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	(*a*)21,852,366	57.29	38,145,718
1889	10,486,185	29.28	6,294,073	17.57	(*a*)19,036,835	53.15	35,817,093
1890	10,867,822	29.68	6,329,658	17.28	(*a*)19,417,979	53.04	36,615,459
Total...	264,363,696	35.76	134,828,394	18.24	339,998,900	46.00	739,190,990

a Includes Loyalsock field.

The figures shown in the above table represent the actual shipments to market by rail and water, including the coal forwarded to tidewater and other storage docks for further transportation. The colliery consumption and the local sales at mines (not transported) are not included.

The quantity of coal produced in each of the counties comprising the anthracite fields of Pennsylvania, during the years 1889 and 1890, is shown in the following tables:

Production of Pennsylvania anthracite coal of all grades, by counties, in 1889.

Counties.	Total product of coal of all grades for year 1889.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for heat and steam at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna and Sullivan	351, 842	319, 126	5, 820	26, 896
Lackawanna	8, 939, 621	7, 823, 694	588, 535	527, 392
Luzerne	16, 607, 177	14, 892, 324	446, 036	1, 268, 817
Carbon	1, 210, 973	1, 080, 544	19, 592	110, 837
Schuylkill	9, 052, 619	7, 837, 369	181, 893	1, 033, 357
Columbia	628, 695	539, 273	15, 663	73, 759
Northumberland	3, 176, 740	2, 770, 914	57, 857	347, 969
Dauphin	697, 485	553, 632	14, 184	129, 669
Total	40, 665, 152	35, 816, 876	1, 329, 580	3, 518, 696

Production of anthracite coal, of all grades, in 1890, by counties.

Counties.	Total product of coal of all grades for year 1890.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for steam and heat at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna and Sullivan	419, 839	399, 315	4, 569	15, 955
Lackawanna	9, 109, 330	7, 978, 765	791, 716	338, 849
Luzerne	16, 892, 099	15, 189, 715	599, 968	1, 102, 416
Carbon	1, 252, 636	1, 101, 018	26, 195	125, 423
Schuylkill	9, 228, 434	7, 996, 874	246, 086	985, 474
Columbia	640, 692	550, 510	21, 026	69, 156
Northumberland	3, 234, 900	2, 851, 769	66, 242	316, 889
Dauphin	711, 928	549, 076	30, 708	132, 144
Total	41, 489, 858	36, 617, 042	1, 786, 510	3, 086, 306

The largest actual shipment during any year in the history of the trade was made in 1888, being 38,145,178 tons of 2,240 pounds. The largest actual shipment for any one month was 4,187,527 tons, in October, 1888. The largest actual shipments ever made in each of the months of any year to December, 1890, inclusive, are given in the table below, and show that, if the mines should be operated as actively in each month of the year as they ever have been in that month, the product for the year would be a little less than 40,000,000 long tons.

Largest shipments of anthracite for each month of any year.

Years.	Months.	Tonnage.
1889	January	2, 622, 529
1887	February	2, 551, 003
1887	March	2, 911, 272
1888	April	2, 856, 593
1889	May	3, 016, 531
1889	June	3, 038, 216
1889	July	3, 627, 522
1888	August	4, 097, 563
1888	September	3, 916, 336
1888	October	4, 187, 527
1888	November	3, 718, 652
1887	December	3, 068, 079
	Maximum shipment practicable	39, 611, 818

Average monthly tonnage based upon the largest shipments ever made	3, 300, 984
Average annual shipments during ten years ending with 1889	31, 551, 301
Average annual shipments during five years ending with 1889	34, 390, 868

The initial lines of transportation from the anthracite coal fields are operated by the following companies:

Delaware, Lackawanna and Western Railroad Company.
New York, Susquehanna and Western Railroad Company.
New York, Ontario and Western Railroad Company.
Delaware and Hudson Canal Company.
Erie and Wyoming Valley Railroad Company.
Central Railroad Company of New Jersey.
Lehigh Valley Railroad Company.
Pennsylvania Railroad Company.
Philadelphia and Reading Railroad Company.
New York, Lake Erie and Western Railroad Company.

The reports formerly made showing the shipments of coal by the respective initial railroad lines traversing the anthracite fields of Pennsylvania were discontinued at the close of 1888, owing to the confusion arising from the liability to duplicate certain tonnages originating upon one line and delivered to another near the mines for transportation to market. It is therefore impracticable to continue the comparative tables of such shipments which have hitherto appeared in this volume.

The tables below show the general distribution of the anthracite coal for 1889 and 1890, shipped as above stated, based upon the most reliable data available. The Survey has not been able to obtain reports for 1890 sufficiently complete from the transportation lines of the country to insure the degree of accuracy desired, and has therefore been compelled to approximate in many cases.

Distribution of anthracite coal for 1889.

Sections.	Long tons.	Per cent.
Pennsylvania, New York, and New Jersey	22, 314, 331	63. 02
New England States	5, 407, 357	15. 27
Western States	4, 922, 076	13. 90
Southern States	1, 613, 120	4. 56
Pacific Coast	20, 900	0. 06
Canada	1, 094, 736	3. 09
Foreign	35, 190	0. 10
Total	35, 407, 710	100. 00

Distribution of anthracite coal for 1890.

Sections.	Long tons.	Per cent.
Pennsylvania, New York, and New Jersey	22,719,221	62.05
New England States	5,442,556	14.86
Western States	5,459,320	14.91
Southern States	1,742,521	4.76
Pacific Coast	11,100	0.03
Canada	1,196,788	3.27
Foreign	45,536	0.12
Total	36,617,042	100.00

The cost of mining anthracite coal and preparing it for shipment is governed by so many conditions, which vary greatly in different localities, and in the diversity of practice, that no compilation would be of value which comprehended any large number of operations. A valuable and interesting statement, however, upon this subject, from data compiled from the books of a single establishment, was prepared by the late Dr. Charles A. Ashburner, and was published in the volume of Mineral Resources for 1888, pp. 329, 330, to which attention is directed.

During the past year much interest has been developed upon the subject of the utilization of the anthracite coal waste, i. e., the screenings resulting in the preparation of the coal into regular sizes at the breakers. This waste, aside from the fact that it constitutes a large per cent of the product which brings no return to the operator and is therefore a loss in the mining account, has become a source of additional expense owing to the difficulty of disposing of it in the vicinity of the breaker. Millions of tons of pure coal are at this moment lying in unsightly pyramids throughout the entire region. The governor of the State has appointed a commission consisting of Hon. Eckley B. Coxe, Mr. P. W. Sheafer, and Mr. J. A. Price, to consider this subject and report upon the same to the next session of the legislature. This commission composed of gentlemen of eminent ability, has collected a vast amount of information to be presented in their forthcoming report, which is awaited with great interest. Mr. Coxe, in an address delivered before the Wilkesbarre Board of Trade, makes this reference to the subject:

"The future prosperity of the (Wyoming) Valley depends in a great measure upon the utilization of the waste coal product. This can not be done, however, by sending it away to other points, but by bringing here such enterprises as can use this waste fuel with profit. If instead of shipping the smaller sizes of coal to distant points and selling it for 30 or 40 cents a ton, we had industries here that would use it in the employment of labor, the result would be much more satisfactory to the people of this region. Wherever we travel in the anthracite region we see vast piles of culm blazing, almost priceless fuel going up in smoke—wasted. Every pound of that culm produces heat that might be used to advantage in scores of industries were it only utilized as it should be. This gives us something to think about. Wherever such waste is seen, we know that somewhere in this country people are going without shoes who might be clothed and fed were the waste stopped and the waste material utilized."

Various schemes for utilizing this waste, by the manufacture of compressed fuel, in combination with combustible volatile substances, have been attempted, but none as yet have attained commercial importance in competition with the natural product.

Much confusion and inconvenience in the marketing of anthracite coal has been, in times past, occasioned by the want of uniformity in the sizes of the coal produced. At a meeting held for the purpose in Wilkesbarre this subject was considered, and the following sizes of meshes were adopted, to take effect January 1, 1891:

Egg, through 2⅝ inches and over 2 inches.
Stove, through 2 inches and over 1½ inches.
Chestnut, through 1½ inches and over ¾ inch.
Pea, through ¾ inch and over ½ inch.
Buckwheat, through ½ inch and over ¼ inch.
No. 2 buckwheat, through ¼ inch and over ⅛ inch.

It will be observed that the size known as "small stove" has been omitted. The meeting at which the above action was taken was composed of operators from every part of the anthracite fields, and represented over 90 per cent. of the entire production. Apropos of the classification of anthracite coal by sizes, the following interesting statement has been prepared by Mr. F. E. Saward, of the *Coal Trade Journal*, relating to the changes taking place in the proportions of the several sizes required by the markets:

"It is an interesting fact that while the output of anthracite has increased in the past ten years, there has been a radical change in the proportions of each size of coal made at the breakers. Why this is so is known to those who are more familiar with the course of events, but the average reader may have lost sight of the fact that the furnace trade has dropped off, while the steam coal trade has changed from one size to another.

"New markets have been opened for the increased quantity of the domestic sizes that have been made, but the making of so great a quantity has caused a lessening of the price, and it has also caused a larger percentage of the smaller coals (now largely used for steam) to be made; these have been disposed of for steam purposes as against soft or bituminous coals. It is doubtful if the gross result in dollars and cents is much beyond the result for the quantity marketed ten years ago.

"We have been led to these conclusions by the perusal of the figures showing the percentages made by one of the larger producers of Lehigh coal in the years 1879 and in 1889.

Percentage output of various sizes of anthracite made by a producer in the Lehigh region.

Sizes.	1879.	1889.
Lump and steamer	15.8	8.91
Broken	19.4	16.69
Egg	15.9	13.13
Stove	15.8	13.35
Chestnut	17.4	15.58
Pea	15.2	14.27
Buckwheat and small coals	0.5	18.07

"The percentages made at all the collieries in the Lehigh district in 1879 were as follows:

Percentages of sizes of anthracite in the Lehigh district in 1879.

Sizes.	Per cent.	Sizes.	Per cent.
Lump	24.6	Stove	18.2
Steamer	2.3	Chestnut	16.7
Broken	14.5	Pea	7.9
Egg	15.5	Buckwheat	0.3

"It is doubted if the result would show them to be very far away from those figures recorded above as for one of the principal concerns. That shows a very great increase in the small coals below chestnut, at any rate.

"One of the larger producers in the Wyoming district, whence so much free-burning coal is had, makes the following comparative showing of percentages for the years 1879 and 1889:

Percentage of various sizes of anthracite made by a producer in the Wyoming region.

Sizes.	1879.	1889.
Lump and steamer	11.13	11.00
Broken	16.11	11.00
Egg	14.06	15.00
Stove	30.64	25.00
Chestnut	20.32	21.00
Pea	7.47	9.00
Buckwheat and small	0.27	8.00

"This shows a loss in broken (or former steamer size) and in the stove, to the increase of the smaller sizes, such as pea, buckwheat, etc.

"The percentages of Schuylkill coal have also changed, as the following will show; the figures are the average of all grades of coal, both hard and free burning:

Percentage of various sizes of anthracite produced in the Schuylkill region.

Sizes.	1883.	1889.
Lump and steamer	14.3	9.4
Broken	14.7	14.5
Egg	15.5	13.6
Stove	19.0	14.8
Small stove	5.1	8.4
Chestnut	11.6	12.8
Pea	14.8	18.3
Buckwheat	5.0	8.2

"The changes do not appear so radical in this last statement, for the figures are not at hand for the earlier year named in the other comparative statements, but it is sufficient to show that the growth of the anthracite trade has been mainly on the small coals.

Recapitulation.

	1879.			1889.		
	Lump and steamer.	Domestic.	Smalls.	Lump and steamer.	Domestic.	Smalls.
Lehigh	15.80	68.50	15.70	8.91	58.75	32.34
Wyoming	11.13	81.13	7.74	11.00	72.00	17.00
Schuylkill	14.30	65.90	19.80	9.40	64.10	26.50
Average	13.74	71.84	14.42	9.77	64.95	25.28

"In 1879 the total product was 26,142,689 tons. The percentages were as follows:

Percentages of sizes of anthracite from the Schuylkill region in 1879.

Sizes.	Per cent.	Tons.
Lump and steamer	13.74	3,592,005
Domestic	71.84	18,780,908
Smalls	14.42	3,769,775

"In 1889 the total product was 35,407,710 tons. The percentages were as follows:

Percentages of sizes of anthracite from the Schuylkill region in 1889.

Sizes.	Per cent.	Tons.
Lump and steamer	9.77	3,459,333
Domestic	64.95	22,997,307
Smalls	25.28	8,951,069

"In the item classed as 'domestic' is included all sizes from broken to chestnut—both included—though, as is well known, not all this coal goes for domestic or house use, but the proportion now is infinitely greater than it was ten years ago, for broken and chestnut were then largely used as steam raisers.

"The loss is great in the Schuylkill and Lehigh lump, as these districts supply the furnace trade, which now takes coke; the Wyoming lump is mainly for steam, and that trade appears to have been held."

During the year 1890 extensive developments have been in progress in all parts of the anthracite coal fields. In the southern field, between Tremont and Minersville, new collieries are being constructed by the Lehigh Valley Coal Company, Mr. Calvin Pardee, Messrs. J. P. &

J. H. Hosie, and the Philadelphia and Reading Coal and Iron Company. The latter company has completed the North Brookside and Good Spring collieries in the Lykens district, Silver Creek colliery in the East Schuylkill district, and Maple Hill colliery in the East Mahanoy district. The Midvalley colliery of Messrs. Righter, Leisenring & Co. will begin shipments early in 1891. Oneida colliery of Messrs. Coxe Brothers & Co. is nearly ready for operation.

In the northern field shipments have begun from the following recently completed collieries: Clinton tunnel, Ontario, Washington, Wm. A., Babylon, Pettibone, and Mount Lookout.

The Schuylkill and Lehigh Valley railroad has been opened between Minersville and Lizard Creek Junction, where it connects with the Lehigh Valley system.

The New York, Ontario and Western railroad extension, from Hancock, New York, to Scranton, Pennsylvania, has been opened for traffic, and is receiving coal from several collieries located between Forest City and Scranton.

The large breaker attached to the Neilson colliery of Messrs. J. Langdon & Co., near Shamokin, Pennsylvania, was destroyed by fire May 16, 1890. The central breaker of the Delaware, Lackawanna and Western Railroad Company, near Hyde Park, was destroyed by fire August 18, 1890.

On August 17, several large breakers in the vicinity of Wilkesbarre, Pennsylvania, were damaged by a windstorm. All of them, however, were restored and put in operation before the close of the year.

Extensive storage yards have been constructed at Landingville and at Mahanoy Plane by the Philadelphia and Reading Railroad Company; at South Plainfield by the Lehigh Valley Railroad Company; and at Hampton Junction by the Central Railroad of New Jersey. These, together with the increased storage and dock facilities recently completed by the Lehigh Valley, the Philadelphia and Reading, the Delaware, Lackawanna and Western, and the New York, Lake Erie and Western interests at Buffalo and other lake ports, will enable the companies to conduct mining operations with more regularity, and facilitate the movement of coal during periods of slack trade, thus insuring not only more steady work for the employés at the mines, but will enable the companies to meet demands for particular sizes on short notice. Not the least of the advantages gained by the establishments of these storage yards is the increased expedition in the handling of cars.

The continued mild weather in the early part of the year, coupled with the constant tendency to overproduction caused a weakening of prices in the Eastern markets which had its effect also upon the Western rates, and before the close of the first half of the year prices had reached a point lower than at the corresponding period in 1889. Many retailers and consumers, taking advantage of this condition of affairs, increased their orders and secured sufficient coal to meet their requirements until far into the autumn and early winter months. Efforts were made to advance prices during the latter half of the year, and the advances were announced by the usual circulars, but to what extent these prices were obtained it is difficult to say. The product was not controlled, during the year, as contemplated by the action of the producers, to meet the actual demands of the markets; nevertheless, the conditions at the close of the year were not discouraging. The stocks at tidewater shipping points at the close of the year were only about one-half what they were at the beginning, while the shipments were half a million tons greater during the year 1890 than the previous year. The regular increase in the consumption of anthracite coal goes on from year to year, though it is difficult to determine the exact ratio. The tables show, approximately, the percentage in general distribution, but it is well understood that all this is subject to modification, owing to the large and varying quantities of coal in stock at the interior points of storage, all of which has been counted in the tonnage statement.

Bituminous coal has not made the inroads upon the anthracite markets predicted by those interested in the former fuel. The small sizes of anthracite, pea, buckwheat, etc., being supplied in larger quantities and with more certainty of steady supply, have not only held their own but have found new demands at fairly remunerative prices. The rates of transporation, of course, must be low, and this has been recognized by the railroad companies who provide special tariffs for the small sizes.

PENNSYLVANIA BITUMINOUS COAL.

Total product in 1889, 36,174,089 short tons; spot value, $27,953,315.
Total product in 1890, 42,302,173 short tons; spot value, $35,376,916.

The bituminous coal fields of Pennsylvania form the northeastern end of the Appalachian field. The total area underlaid by workable coal beds is about 900 square miles. The coal mines of the State are confined to twenty-seven counties, later enumerated. The largest coal area is contained in the western and southwestern parts of the State, extending west from the crest of the Allegheny mountains to the Ohio line, and southwest of a line drawn from New Castle, in Lawrence county, northeast to Kane, in McKean county, and thence southeast in the direction of Bellefonte, in Center county. Ragged edges of broken Coal Measures extend beyond these lines. In addition, isolated areas are found in the Wellersburg Basin, in Somerset county; in the Broad Top coal field, in Huntingdon, Blair, and Fulton counties; in the Tipton field, west of Altoona, in Blair county, and in the fields in Bradford and Tioga counties. The characteristics of the Coal Measures in which these beds occur have been described in former reports.

Notwithstanding the fact that the total product of bituminous coal in the United States for 1889 was 2,485,812 short tons less than in 1888, the production of Pennsylvania increased 2,377,362 short tons, a gain nearly as great as the total decrease, and shows the loss sustained by other States to have been 4,863,174 short tons. The increase in the product of bituminous coal in Pennsylvania in 1888 was 2,279,871 short tons. This was in a year of general increase and represented only about 17 per cent. of the total gain. The increase, from a comparative standpoint, in 1889 is a remarkable one. The returns for 1890 show an increase in the product of Pennsylvania bituminous coal of 6,128,084 short tons. The details of the respective increases and decreases in the production, by counties, for the two years is shown in the following table, together with a statement of the production in 1886, 1887, and 1888:

Comparative statistics of the Pennsylvania bituminous mines, by counties.

Counties.	1886.	1887.	1888.	1889.			1890.		
				Total product.	Increase over 1888.	Decrease from 1888.	Total product.	Increase over 1889.	Decrease from 1889.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	4, 202, 086	4, 680, 924	5, 575, 505	4, 717, 431		858, 074	4, 894, 372	176, 941	
Armstrong	210, 856	235, 221	226, 093	289, 218	63, 125		380, 554	91, 336	
Beaver	208, 820	197, 863	63, 900	93, 461	29, 561		139, 117	45, 656	
Bedford	173, 372	311, 452	248, 159	257, 455	9, 294		445, 192	187, 739	
Blair	305, 695	287, 367	314, 013	215, 410		98, 603	298, 196	82, 786	
Bradford	206, 998	167, 416	163, 851	129, 141		34, 710	126, 687		2, 454
Butler	162, 306	161, 764	194, 715	288, 591	93, 876		167, 578		121, 013
Cambria	1, 222, 028	1, 421, 980	1, 540, 460	1, 751, 664	211, 204		2, 790, 954	1, 039, 290	
Cameron	3, 200	3, 000	700	2, 300	1, 600				(d)
Center	313, 383	508, 255	382, 770	395, 127	12, 357		452, 114	56, 987	
Clarion	429, 544	593, 758	535, 192	596, 589	61, 397		512, 387		84, 202
Clearfield	3, 753, 986	5, 180, 311	5, 398, 981	5, 224, 506		174, 475	6, 651, 587	1, 427, 081	
Clinton			32, 000	106, 000	74, 000		159, 000	53, 000	
Elk	526, 036	609, 757	555, 960	614. 113	58, 153		1, 121. 534	507, 421	
Fayette	4, 494, 613	4, 540, 322	5, 208, 993	5, 897, 254	688, 261		6, 413, 081	515, 827	
Greene	5, 600	3, 002	5, 323	53, 714	48, 391		(b)		(d)
Huntingdon	313, 581	265, 479	281, 823	280, 133		1, 690	322, 630	42, 497	
Indiana	103, 615	207, 597	157, 285	153, 698		3, 587	357, 580	203, 882	
Jefferson	1, 023, 186	1, 693, 492	2, 275, 349	2, 896, 487	621, 138		2, 850, 799		45, 688
Lawrence	101, 154	125, 361	106, 921	143. 410	36, 489		140, 528		2, 882
McKean	617	9, 214	10, 443	11, 500	1, 057		(b)		(d)
Mercer	537, 712	539, 721	487, 122	575, 751	88, 629		524, 319		51, 432
Somerset	349, 926	416, 240	370, 228	442, 027	71, 799		522, 796	80, 769	
Tioga	1, 384, 800	1, 328, 963	1, 106, 146	1, 036, 175		69, 971	903, 997		132, 178
Venango	2, 500	2, 296	2, 000	6, 911	4, 911		(b)		(d)
Washington	1, 612, 407	1, 751, 615	1, 793, 022	2, 364, 901	571, 879		2, 836, 667	471, 766	
Westmoreland	5, 446, 480	6, 074, 486	6, 519, 773	7, 631, 124	1, 111, 351		8, 290, 504	659, 380	
Unreported mines and country banks employing less than 10 miners (estimated)		200, 000	240, 000	(a)			(c)1, 000, 000	925, 575	
Total	27, 094, 501	31, 516, 856	33, 796, 727	36, 174, 089	3, 852, 472	1, 241, 110	42, 302, 173	6, 567, 933	439, 849
Net increase		4, 422, 355	2, 279, 871	2, 377, 362	2, 377, 362		6, 128, 084	6, 128, 084	

a Included in county distribution. *b* Included in product of country banks. *c* Estimate based on the census returns for small banks, which for 1889 were, approximately 800,000 short tons, showing that previous estimates of the product from this source were too small. *d* All product from country banks and decrease deducted from total estimated production.

It will be seen from the foregoing table that in 1889 Allegheny county suffered the greatest loss in tonnage, having over 66 per cent. of the loss sustained in all the counties in which decreases in product occurred. Westmoreland county showed a remarkable increase, being nearly one-half of the total net increase of the State, and exceeding by 38,058 short tons the aggregate increase of the county from 1886 to 1888. Fayette county came second in increased tonnage, with a gain of 688,261 short tons; Jefferson third, with an increase of 621,138 short tons, and Washington, fourth, shows 571,879 short tons in excess of the preceding year's product. In remarking upon the decrease of product in Allegheny county it may be well to call attention to the statement made under the coal trade review of Pittsburg, that the shipments had fallen off 29,993,900 bushels (of 76 pounds), or something over 1,000,000 short tons. Allowing for a production based upon an expectation of a demand which did not materialize, it will be seen that the two statements are compatible, and the fact that the decrease in production was not so great as the decrease of shipments will in part account for the comparatively small increased production in 1890.

In 1890 the county showing the greatest gain on the preceding year was Clearfield, whose product in 1890 was 1,427,081 short tons greater than in 1889. Cambria county increased 1,039,290 short tons, and the other notable increases were in Westmoreland county, 659,380 short tons; Fayette county, 515,827 short tons; Elk county, 507,421 short tons, and Washington county, 471,766 short tons. The counties having an increased production in 1889 and an apparent decreased product in 1890 were Butler, Clarion, Jefferson, Lawrence, and Mercer. But against this must be set the fact that the product of small mines is included in the county distribution in 1889 and not accounted for in 1890, except in a total estimate for the State.

The following tables show the bituminous coal product of Pennsylvania in 1889 and 1890, by counties, with the distribution and value:

Bituminous coal product of Pennsylvania in 1889, by counties.

Counties.	Disposition of total product.				Total product.	Value of total product at mines.	Average number of persons employed.
	Loaded at mines for shipment on railroad cars and boats.	Used by employés and sold to local trade.	Used for steam and heat. at mines.	Made into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Allegheny	4,464,376	204,282	25,103	23,670	4,717,431	$4,000,104	9,386
Armstrong	229,402	59,460	356	....	289,218	210,067	459
Beaver	44,932	48,180	249	100	93,461	110,604	162
Bedford	237,554	6,932	3,889	9,078	257,453	265,672	560
Blair	80,777	4,188	2,918	127,527	215,410	210,466	466
Bradford	121,976	6,365	800	....	129,141	171,387	321
Butler	183,477	94,064	2,162	8,888	288,591	270,394	451
Cambria	1,174,506	179,525	7,296	390,335	1,751,664	1,348,484	2,791
Center	380,331	4,964	115	9,717	395,127	311,544	750
Clarion	535,251	57,500	3,370	468	596,589	430,850	940
Clearfield	4,937,506	89,580	19,651	177,769	5,224,506	4,403,551	7,703
Elk	596,014	7,549	4,789	5,761	614,113	498,728	1,185
Fayette	593,149	111,714	101,272	5,091,119	5,897,254	3,702,548	6,567
Greene	....	53,714	....	....	53,714	57,307	....
Huntingdon	185,799	9,111	3,129	82,094	280,133	211,597	538
Indiana	53,498	80,200	....	20,000	153,698	124,088	139
Jefferson	2,371,703	53,684	11,403	459,697	2,896,487	2,117,531	3,738
Lawrence	117,094	25,696	620	....	143,410	150,537	267
Mercer	509,737	51,231	14,783	....	575,751	511,202	1,094
Somerset	370,791	50,909	586	19,741	442,027	308,400	525
Tioga	1,010,544	12,572	8,543	4,516	1,036,175	1,264,889	2,400
Washington	2,261,040	64,847	11,972	27,042	2,364,901	1,557,486	4,005
Westmoreland	3,488,873	299,874	109,597	3,732,780	7,631,124	5,674,493	9,109
Cameron, Clinton, Lycoming, McKean and Venango	111,581	14,510	334	286	126,711	101,386	224
The State	24,059,913	1,590,651	332,937	10,190,588	36,174,089	27,953,315	58,780

Bituminous coal product of Pennsylvania in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Allegheny	4,643,050	174,870	37,496	38,956	4,894,372	$4,534,708	198	9,036
Armstrong	341,447	11,064	2,480	25,563	380,554	275,011	251	661
Beaver	119,216	18,355	1,286	260	139,117	145,946	251	205
Bedford	305,282	10,279	1,400	128,231	445,192	356,005	288	662
Blair	163,399	1,852	506	132,439	298,196	241,678	284	595
Bradford	121,359	1,355	3,973	....	126,687	161,751	196	292
Butler	147,935	9,372	2,471	7,800	167,578	146,162	237	314
Cambria	2,487,414	26,348	15,186	262,006	2,790,954	2,332,997	361	4,140
Center	378,384	5,684	200	67,846	452,114	356,121	230	623
Clarion	501,563	8,425	2,399	....	512,387	386,617	237	938
Clearfield	6,351,454	9,629	61,715	228,789	6,651,587	5,642,098	236	9,324
Clinton	159,000	....	....	....	159,000	123,326	265	209
Elk	1,064,372	11,788	374	45,000	1,121,534	942,081	255	1,871
Fayette	996,469	12,044	123,264	5,281,304	6,413,081	4,931,015	247	6,508
Huntingdon	229,855	8,486	3,222	81,067	322,630	247,364	237	611
Indiana	283.102	2,184	112	72,182	357,580	294,389	245	668
Jefferson	2,678,522	7,805	6,820	157,652	2,850,799	2,421,960	245	3,971
Lawrence	94,908	45,109	511	....	140,528	142,682	232	307
Mercer	488,205	25,313	10,801	....	524,319	446,392	231	1,023
Somerset	486,322	10,041	593	25,840	522,796	341,518	225	646
Tioga	852,621	19,986	11,405	19,985	903,997	995,936	192	2,019
Washington	2,775,610	8,253	12,454	40.350	2,836,667	2,649,627	227	4,644
Westmoreland	3,619,434	45,075	97,169	4,528,826	8,290,504	6,691,532	228	12,080
Small mines	....	1,000,000	....	....	1,000,000	750,000	....	....
Total	29,288,923	1,473,317	395,837	11,144,096	42,302,173	35,376,916	(a)232	61,333

a Average for the State.

ALLEGHENY COUNTY.

(Coal produced in 1889, 4,717,431 short tons; 1890, 4,894,372 short tons.)

The coal product of Allegheny in 1888 was 894,581 short tons in excess of the product of the preceding year, and this gain was greater than that of any other county with the exception of Westmoreland. This was followed by a revulsion of trade in 1889, for the product decreased 858,074 short tons, falling back to within 36,507 short tons of the product of 1887. In 1890 the product was 176,941 short tons more than in 1889; it was 681,133 short tons less than 1888, and 213,448 short tons more than in 1887.

The following table exhibits the product of Allegheny county since 1884:

Coal product of Allegheny county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	2, 863, 631	1888	5, 575, 505
1885	3, 588, 244	1889	4, 717, 431
1886	4, 202, 086	1890	4, 894, 372
1887	4, 680, 924		

The following table shows the shipments from the Pittsburg district by slack-water navigation down the Monongahela and Ohio rivers since 1860:

Shipments of Pittsburg coal by slack-water navigation since 1860.

Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*
1860	1, 517, 909	1876	2, 495, 800
1861	834, 630	1877	2, 677, 460
1862	743, 358	1878	2, 797, 530
1863	1, 134, 150	1879	2, 623, 232
1864	1, 402, 828	1880	3, 361, 934
1865	1, 580, 791	1881	3, 450, 186
1866	1, 704, 212	1882	4, 057, 384
1867	1, 202, 908	1883	4, 339, 492
1868	1, 812, 040	1884	3, 170, 900
1869	2, 100, 504	1885	3, 298, 200
1870	2, 303, 856	1886	4, 123, 945
1871	1, 944, 852	1887	3, 065, 240
1872	2, 291, 220	1888	4, 498, 430
1873	2, 094, 312	1889	4, 250, 000
1874	2, 503, 504	1890	4, 400, 000
1875	2, 275, 265		

ARMSTRONG COUNTY.

(Coal produced in 1889, 289,218 short tons; 1890, 380,554 short tons.)

This county produced 9,128 tons less in 1888 than in 1887. The product in 1889 was 63,125 tons more than in 1888, and an increase of 91,336 tons over 1889 is noted in the product of 1890. The annual production of Armstrong county for seven years has been as follows:

Coal product of Armstrong county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	170,826	1888	226,093
1885	189,327	1889	289,218
1886	210,856	1890	380,554
1887	235,221		

BEAVER COUNTY.

(Coal produced in 1889, 93,461 short tons; 1890, 139,117 short tons.)

The product of coal in Beaver county in 1889 was 29,561 short tons more than in 1888, in which year the product fell off two-thirds from 1887. In 1890 a further gain of 45,656 tons was made, but the loss of 1888 was not made up, the product of 1890 being still 58,746 tons short of the yield in 1887.

Coal product of Beaver county, Pennsylvania, for seven years.

Years.	Short tons.	Years.	Short tons.
1884	156,695	1888	63,900
1885	184,631	1889	93,461
1886	208,820	1890	139,117
1887	197,863		

BEDFORD COUNTY.

(Coal produced in 1889, 257,453 short tons; 1890, 445,192 short tons.)

The coal mines of this county, together with those of Huntington and the greater portion of those of Blair, are located in the broad top semi-bituminous coal basin. There was an increased production in 1889 over 1888 of 9,294 short tons, followed by a large increase in 1890 of 187,739 tons.

The coal beds of this county belong to the Lower Productive Coal Measures. The names which have been adopted for these coal beds have been local, since it has only been within the last few years that the geological survey of the State has established the identity of these coal beds with those of the Freeport, Kittanning, and Clarion beds of the western Pennsylvania bituminous coal fields.

The annual production of Bedford county for seven years has been as follows:

Coal product of Bedford county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	69,770	1888	248,159
1885	107,694	1889	257,453
1886	173,372	1890	445,192
1887	311,452		

BLAIR COUNTY.

(Coal produced in 1889, 215,410 short tons; 1890, 298,196 short tons.)

The total product in this county in 1889 was 98,603 tons less than in 1888. In 1890 the product increased 82,786 tons over 1889. The falling off in 1889 was due, not to the suspension of any one or more mines, but to a decreased output at each one of the seven important mines of the county. The reaction in 1890 was also participated in by all the producing companies with one exception.

Coal product of Blair county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	208, 541	1888	314, 013
1885	205, 075	1889	215, 410
1886	305, 695	1890	298, 196
1887	287, 307		

BRADFORD COUNTY.

(Coal produced in 1889, 129,141 short tons; 1890, 126,687 short tons.)

The annual coal product of this county shows a steady decrease in amount since 1884. The decrease in 1889 from 1888 was 34,710 short tons. The succeeding decrease in 1890 was 2,454 short tons. Only two companies are operating in the county on a commercial scale, the Towanda Coal Company and the Long Valley Coal Company, the former having been producing coal continuously since 1856. The following table exhibits the total product of the county since 1884:

Coal product of Bradford county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	313, 575	1888	163, 851
1885	249, 920	1889	129, 141
1886	206, 998	1890	126, 687
1887	167, 416		

BUTLER COUNTY.

(Coal produced in 1889, 288,591 short tons; 1890, 167,578 short tons.)

The total product of this county for 1888 was reported at 194,715 short tons. The seemingly large increase in 1889, and as notable a decrease in 1890, are due simply to the numerous small mines in the county, whose product, included in the returns for 1889, was 91,615 short tons. Deducting this factor from the total product in 1889 and comparing with the statistics for the preceding and succeeding years, it shows an increase over the product of 1889 of 2,261 short tons and a decrease in 1890 of 29,398 tons, *Coal product of Butler county, Pennsylvania, from 1884 to 1890.*

Years.	Short tons.	Years.	Short tons.
1884	151,355	1888	194,715
1885	85,429	1889	288,591
1886	162,306	1890	167,578
1887	161,764		

CAMBRIA COUNTY.

(Coal produced in 1889, 1,751,664 short tons; 1890, 2,790,954 short tons.)

The coal product of Cambria county has increased each year since 1884. The increase in 1889 over the proceding year was 211,204 short tons, or nearly 14 per cent., while that in 1890 was 1,039,290 short tons, or within a fraction of 60 per cent. greater that the output of 1889. With the exception of Clearfield, the gain in the product of Cambria county was the largest in the State during the year, being 379,910 tons more than the gain of Westmoreland county, which comes third in increased production.

The following table exhibits the annual output of the coal mines of Cambria county since 1884:

Coal product of Cambria county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	659,843	1888	1,540,460
1885	1,037,000	1889	1,751,664
1886	1,222,028	1890	2,790,954
1887	1,421,980		

CAMERON COUNTY.

The product of coal in Cameron county in 1889 was 2,300 short tons, the output of one mine which went into the hands of a receiver in 1890, and no production was reported for that year.

CENTER COUNTY.

(Coal produced in 1889, 395,127 short tons; 1890, 452,114 short tons.)

The total product of this county for 1889 was 12,357 tons greater than during the previous year. In 1890 a further increase of 56,987 short tons was made.

Although the coal mined in the Snow Shoe basin in Center county has long been favorably known by the coal trade as a superior coal, yet the limited areas which are underlaid by coal beds, and the cost of mining as compared to more favorable conditions which exist in Clearfield county, immediately to the west, have had a direct influence in diminishing the product of Center county. The large increase in the product of Clearfield county in 1890 and comparatively small gain in Center afford abundant proof of the advantages possessed by the former.

Coal product of Center county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	216, 422	1888	382, 770
1885	373, 504	1889	395, 127
1886	313, 383	1890	452, 114
1887	508, 255		

CLARION COUNTY.

(Coal produced in 1889, 596,589 short tons; 1890, 512,387 short tons.)

Clarion county is one of the five bituminous coal producers which had an increased product in 1889, and a falling off in 1890 when the general tendency was toward increased business. The total product of this county in 1889 was 61,397 tons greater than during the previous year, and in 1890 84,202 tons less than during 1889. The annual production of the county for seven years has been as follows:

Coal product of Clarion county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	329, 973	1888	535, 192
1885	299, 216	1889	596, 589
1886	429, 544	1890	512, 387
1887	593, 758		

CLEARFIELD COUNTY.

(Coal produced in 1889, 5,224,506 short tons; 1890, 6,651,587 short tons.)

The general depression in the coal trade in 1889 is exemplified by the product of Clearfield county, which from having a steady annual increase for five years, fell off in 1889, 174,475 short tons and increased 1,427,081 tons in 1890. The average yearly increase from 1884 to 1888 was 805,359 short tons, and from 1884 to 1890, 745,507 short tons, indicating that an ordinary business in 1889 would have given Clearfield county a practically steady annual increase in product.

The rapid development of the mines of Clearfield county is sufficiently shown in the coal tonnages of the Tyrone and Clearfield branch of the Pennsylvania railroad during the last twenty-nine years, and also in the tonnages of the Beech Creek railroad, which are given below:

Coal carried over the Tyrone and Clearfield branch railroad during the last twenty-seven years.

Years.	Short tons.	Years.	Short tons.
1862	7, 239	1877	1, 374, 927
1863	24, 330	1878	1, 295, 201
1864	65, 380	1879	1, 631, 120
1865	60, 629	1880	1, 739, 873
1866	107, 878	1881	2, 401, 987
1867	166, 364	1882	2, 838, 970
1868	170, 335	1883	2, 857, 710
1869	259, 994	1884	3, 173, 303
1870	379, 863	1885	2, 901, 613
1871	542, 896	1886	2, 273, 147
1872	431, 915	1887	3, 256, 328
1873	592, 860	1888	3, 389, 864
1874	639, 630	1889	3, 215, 630
1875	928, 297	1890	3, 389, 450
1876	1, 281, 861		

Beech Creek railroad tonnage.

Years.	Short tons.	Years.	Short tons.
1884	234, 751	1888	1, 694, 495
1885	774, 055	1889	1, 556, 930
1886	1, 050, 238	1890	2, 081, 173
1887	1, 351, 579		

Coal product of Clearfield county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	2, 177, 543	1888	5, 398, 981
1885	3, 368, 671	1889	5, 224, 506
1886	3, 753, 986	1890	6, 651, 587
1887	5, 180, 311		

CLINTON COUNTY.

(Coal produced in 1889, 106,000 short tons; 1890, 159,000 short tons.)

There are many isolated areas of the top lands of this county which are underlaid by the lower beds of the Lower Productive Coal Measures. These beds have been prospected and worked on a commercial scale at various times during the past twenty-seven years. The thinness of many of the beds, the poor character of the coal as compared with that in other counties, and their height in the hilltops above the grade of railroad lines have all militated against the extensive development of the coal, although it is estimated that there are between 15,000 and 20,000 acres of land in the county underlaid by workable coal beds, which have an aggregate available tonnage of about 60,000,000 tons. Since 1884, and up to 1888, no product from this county has been reported. In the latter year the product was 32,000 short tons.

ELK COUNTY.

(Coal produced in 1889, 614,113 short tons; 1890, 1,121,534 short tons.)

The total product of this county in 1889 was 58,153 short tons greater than during the previous year, and in 1890 took a remarkable jump, gaining 507,421 short tons over 1889. The largest producer in the county is the Northwestern Mining and Exchange Company, operating both in Elk and Jefferson counties. The annual product of the county for seven years is exhibited in the following table:

Coal product of Elk county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	413,243	1888	555,960
1885	537,826	1889	614,113
1886	526,086	1890	1,121,534
1887	609,757		

FAYETTE COUNTY.

(Coal produced in 1889, 5,897,254 short tons; 1890, 6,413,081 short tons.)

The total product of Fayette county has increased very regularly since 1887. The increase in 1888 over the previous year was 668,671 short tons. In 1889 the increase was 688,261 tons, and in 1890 515,827 tons. The largest operator for a number of years has been the H. C. Frick Coke Company, whose total product in this county in 1890 was 3,543,826 tons, of which 3,456,336 tons were made into coke, the remainder, 87,490 tons, being consumed at the mines. Of the total product of the county in 1889, 5,091,119 tons were made into coke, and 5,281,304 tons were so consumed in 1890. The annual product of the county since 1884 has been as follows:

Coal product of Fayette county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	4,041,643	1888	5,208,993
1885	3,192,172	1889	5,897,254
1886	4,494,618	1890	6,413,081
1887	4,540,322		

GREENE COUNTY.

The total product of Greene county in 1889 was 53,714 short tons, all of which was from mines not considered of commercial importance and not accounted in the returns for 1890, except in the total estimate for the State. The entire county is underlaid with valuable coal beds, but they are at such depth that the cost of production is too great to admit of competition with more favorable localities.

HUNTINGDON COUNTY.

(Coal produced in 1889, 280,133 short tons; 1890, 322,630 short tons.)

The total product of this county in 1889 was 1,690 tons less than during the previous year. The product in 1890 was 42,497 tons greater than during 1889.

This coal fields of the county are contained exclusively in the Broad Top semi-bituminous field. The mines are opened on both sides of what is known as the Broad Top Mountain field, on both sides of the mountain, being known respectively as the east and west fields.

On account of the superior character of the coal it is much sought for by the trade to supply special consumers. Although a very small area of the southwestern corner of the county is underlaid by coal beds, yet the amount of available coal is very considerable, and there are no facts to warrant the popular impression that the coal beds will be early exhausted, since the amount of available tonnage contained is such as to make it impracticable at the present time to enter into any speculation on this question.

Coal product of Huntingdon county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	212,587	1888	281,823
1885	247,424	1889	280,133
1886	313,581	1890	322,630
1887	265,479		

Coal carried by the Huntingdon and Broad Top railroad to the Pennsylvania railroad at Huntingdon.

Years.	Short tons.	Years.	Short tons.
1873	350,245	1882	271,216
1874	226,693	1883	196,534
1875	204,921	1884	192,706
1876	159,779	1885	176,075
1877	140,143	1886	385,796
1878	150,204	1887	357,438
1879	141,594	1888	375,958
1880	174,736	1889	376,801
1881	204,819	1890	515,309

Coal carried by the East Broad Top railroad to the Pennsylvania railroad at Mount Union.

Years.	Short tons.	Years.	Short tons.
1875	43,567	1883	44,737
1876	66,104	1884	43,514
1877	54,738	1885	51,878
1878	63,068	1886	51,050
1879	67,929	1887	48,581
1880	72,450	1888	55,795
1881	91,745	1889	72,258
1882	99,095	1890	70,764

Coal product of Huntingdon county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	212,527	1888	281,823
1885	247,424	1889	280,133
1886	313,581	1890	322,630
1887	265,479		

INDIANA COUNTY.

(Coal produced in 1889, 153,698 short tons; 1890, 357,580 short tons.)

The total product for this county for 1889 was 3,587 tons less than in 1888, and 53,899 tons less than during 1887. The falling off in 1888 and 1889, was due largely to the decreased output of the Saltsburg Coal Company, which fell from 160,000 tons in 1887 to 7,000 in 1889. The product in 1890 increased 203,882 short tons. This gain was due partly to a general increase in the product of all the old producers, and particularly of the Saltsburg Coal Company and the Glenwood Coal Company, which increased from 7,000 and 7,836 tons respectively in 1889 to 87,600 and 69,596 tons in 1890. Five new mines, not reported in 1889, had an aggregate output of 125,152 short tons. The difference in the increase apparent from this statement and that given as the actual increase in the county is due to the exclusion from the returns of 1890 of the product of small mines, which in 1889 amounted to 80,110 short tons. The product of the county for the past seven years has been as follows:

Coal product of Indiana county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	30,758	1888	157,285
1885	82,750	1889	153,698
1886	103,615	1890	357,580
1887	207,597		

JEFFERSON COUNTY.

(Coal produced in 1889, 2,896,487 short tons; 1890, 2,850,799 short tons.)

Jefferson county produced 621,138 more tons in 1889 than in the previous year. The product for 1890 was in reality about the same as in 1889, but the omission of the product of small mines from the total makes an apparent decrease of 45,688 tons. The following table shows the remarkable increases in the amount of coal produced since 1884. The most notable increases occurred in 1886, 1887, and 1888, being approximately 600,000 tons each year and averaging within a fraction of that figure.

Coal product of Jefferson county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	450,079	1888	2,275,349
1885	479,675	1889	2,896,487
1886	1,023,186	1890	2,850,799
1887	1,693,492		

LAWRENCE COUNTY.

(Coal produced in 1889, 143,410 short tons; 1890, 140,528 short tons.)

The total product of this county for 1889 was 36,489 tons greater than during 1888, and (owing to the omission of small mines) 2,882 tons less in 1890 than in 1889. The product of the commercial mines in 1890 was 19,388 greater than the preceding year. Following is the product of the county as reported for seven years:

Coal product of Lawrence county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	42,818	1888	106,921
1885	42,137	1889	143,410
1886	101,154	1890	140,528
1887	125,361		

McKEAN COUNTY.

Including the coal taken out by small operators the product of McKean county in 1889 was 11,500 tons. The Buffalo Coal Company, which had been operating in the county on a commercial scale, but almost exclusively for locomotive use, ceased work in 1889, and the only production in 1890 was by individual diggers. The coal beds of the county are thin and the quality of the coal inferior, and these and other disadvantages prevent large operations.

MERCER COUNTY.

(Coal produced in 1889, 575,751 short tons; 1890, 524,319 short tons.)

Mercer county is one of the five in the State which had an increased product in 1889 and a decreased one in 1890, but in this county the falling off is not entirely attributable to the omission of country banks from the product of the latter year. The decrease in the product of commercial mines amounted to 19,935 short tons. Including the product of small mines in 1889, the decrease is shown to be 51,432 tons. The increase in product from 1888 to 1889 was 88,629 tons.

Coal product of Mercer county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	276,350	1888	487,122
1885	378,508	1889	575,751
1886	537,712	1890	524,319
1887	539,721		

SOMERSET COUNTY.

(Coal produced in 1889, 442,027 short tons; 1890, 522,796 short tons.)

From a decreased product of 46,012 short tons in 1888, as compared with that of 1887, the output of the county shows a gain in 1889 of 71,799 short tons, and another gain in 1890 of 80,769 tons. The falling off in 1888 was due largely to decreased production by the principal operating company. With the exception of the depression in 1888 the production of the county has increased steadily since 1884, as shown in the following table:

Coal product of Somerset county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	269,930	1888	370,238
1885	302,715	1889	442,027
1886	349,926	1890	522,796
1887	416,240		

TIOGA COUNTY.

(Coal produced in 1889, 1,036,175 short tons; 1890, 903,997 short tons.)

In Mineral Resources for 1888 it was stated that it was more than probable that the annual production of this county had already passed its maximum limit. The statement seems to have been borne out, for since 1886, when the largest yearly product is reported, the output has decreased annually. The product for 1889 was 69,971 tons less than during 1888, and in 1890, 132,178 tons less than in 1889. Owing to the unfavorable situation of the coal areas, and their scattered condition, the cost of mining is too great to admit of profitable competition with the more western counties of the State, where conditions are more favorable for economical mining. The production of Tioga county since 1884 is shown in the following table:

Coal product of Tioga county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	931,922	1888	1,106,146
1885	1,067,081	1889	1,036,175
1886	1,384,800	1890	903,997
1887	1,328,963		

The product of the Blossburg district since 1872 has been as follows:

Product of coal in Blossburg region since 1872.

Years.	Short tons.	Years.	Short tons.
1872	849, 262	1882	1, 165, 604
1873	991, 057	1883	1, 217, 870
1874	796, 388	1884	1, 018, 342
1875	581, 782	1885	1, 074, 581
1876	616, 984	1886	1, 388, 611
1877	602, 245	1887	1, 329, 239
1878	652, 597	1888	1, 106, 959
1879	874, 010	1889	1, 035, 926
1880	921, 655	1890	888, 771
1881	1, 178, 581		

VENANGO COUNTY.

There are only a few scattered areas in the southeastern part of Venango county, principally in the townships of Irwin, Clinton, Scrubgrass, Dotters, and Potterfield, which are underlaid by coal beds.

All the coal is mined to supply a local trade. This amounted in 1889 to 6,911 short tons.

WASHINGTON COUNTY.

(Coal produced in 1889, 2,364,901 short tons; 1890, 2,836,667 short tons.)

The total amount of coal produced in this county during 1889 was 571,879 tons greater than during 1888, and in 1890, 471,766 tons greater than in 1889. The product of commercial mines in 1890 was 521,697 short tons greater than in 1889, the output of country banks in 1889 being 49,931 short tons. Washington is destined to be one of the greatest coal-producing counties in the State; but on account of the fact that most of the workable coal beds are situated below water level, and will have to be mined from shafts, the large amount of capital which is required to develop these beds and the cost of operation would necessarily be greater than that in the more northern counties, where the coal beds can be mined above water level. These facts will make the development of the coal beds of the county a slow one. At the present time the Pittsburg coal bed supplies almost the entire product of the county, which is shipped by rail to Chicago, Cleveland, Columbus, and intermediate points, and by boat down the Monongahela river to Ohio and Mississippi river points.

Coal product of Washington county from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	707, 262	1888	1, 793, 022
1885	836, 633	1889	2, 364, 901
1886	1, 612, 407	1890	2, 836, 667
1887	1, 751, 615		

WESTMORELAND COUNTY.

(Coal produced in 1889, 7,631,124 short tons; 1890, 8,290,504 short tons.)

Westmoreland continues to be the queen county of the State in the amount of bituminous coal produced. It has for the past seven years produced more coal than any other county in the Pennsylvania bituminous field. In 1889 the total product was 1,733,870 tons greater than that of Fayette county, which came second. In 1890 the product of Westmoreland county was 1,638,917 tons greater than that of Clearfield, which changed places with Fayette in rank of producing importance. The product of Westmoreland county in 1889 was 1,111,351 greater than in 1888, and 659,380 tons greater in 1890 than in 1889. The product in 1890 was 754,715 tons greater than the product of commercial mines in 1889. The steady increase in the annual product of the county since 1884 may be seen from the following table:

Coal product of Westmoreland county, Pennsylvania, from 1884 to 1890.

Years.	Short tons.	Years.	Short tons.
1884	3,282,733	1888	6,519,773
1885	3,671,072	1889	7,631,124
1886	5,446,480	1890	8,290,504
1887	6,074,486		

TENNESSEE.

Total product in 1889, 1,925,689 short tons; spot value, $2,338,309. Total product in 1890, 2,169,585 short tons; spot value, $2,395,746. The coal product of Tennessee decreased 41,608 short tons in 1889, as compared with that of 1888, but showed an increase in value of $174,283. In 1890 the output increased 243,886 short tons, and the total value $57,437.

The following tables show the amount of coal produced in Tennessee in 1889 and 1890, with the value and distribution of the product:

Coal product of Tennessee in 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.	Total number of employés.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Anderson	442, 319		9, 700	5, 050		457, 069	$531, 920	986
Bledsoe		225				225	280	
Campbell	117, 017	691	2, 985	1, 410	1, 000	123, 103	146, 610	393
Claiborne (*a*)								
Cumberland		124				124	155	
Fentress		25				25	20	
Franklin, Roane, and White	53, 608	1, 401	2, 118	10, 796	106, 628	174, 551	318, 686	390
Grundy	253, 891	280	700	2, 100	143, 136	400, 107	395, 767	501
Hamilton	212, 845	893	60	2, 110	25, 159	241, 007	313, 991	625
Marion	103, 288	2, 663	11	633	97, 328	203, 923	230, 116	423
Morgan	64, 037	3, 452	100	640		68, 229	91, 511	135
Overton and Putnam		10				10	10	
Rhea	2, 000	1, 505	50		145, 639	149, 194	164, 118	475
Scott	85, 419	1, 908	165	295	20, 240	108, 027	145, 075	180
Van Buren		10				10	10	
Warren		25				25	30	
Total	1, 334, 424	13, 212	15, 889	23, 034	539, 130	1, 925, 689	2, 338, 309	4, 108

a Prospecting.

Coal product of Tennessee in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Anderson	574, 058	5, 700	2, 650		582, 403	$680, 249	291	1, 325
Campbell	119, 467	8, 100	3, 800		126, 367	153, 790	212	251
Claiborne (*a*)								
Franklin, Roane, and White	12, 000	4, 554	7, 692	100, 356	124, 602	141, 714	209	315
Grundy	176, 755	2, 849	2, 469	167, 394	349, 467	326, 827	310	880
Hamilton	231, 464	1, 000	1, 500	43, 932	277, 896	318, 328	285	500
Marion	129, 440	12, 700	800	70, 262	213, 202	225, 403	226	523
Morgan	138, 633	4, 845	540		143, 518	158, 243	258	*b* 363
Rhea		3, 170	4, 032	204, 263	211, 465	211, 465	200	450
Scott	100, 545	214	100	35, 506	136, 365	175, 327	241	475
Small mines		4, 300			4, 300	4, 400		
Total	1, 482, 357	41, 932	23, 583	621, 713	2, 169, 585	2, 395, 746	(*c*) 263	5, 082

a Prospecting. *b* One hundred and seventy-five convicts. *c* Average for the State.

Extended descriptions of the Tennessee coal fields have been published in previous reports with numerous analyses of the coals and cokes. The coal-producing regions are divided into three State inspection districts, the first including the counties of Franklin, Grundy, Marion, and White; the second the counties of Hamilton, Morgan, Rhea, Roane, and Scott; and the third the counties of Anderson, Campbell, and Claiborne. The product of these districts in 1888, 1889, and 1890 (exclusive of small banks) was as follows:

Coal product of Tennessee in 1888, 1889, and 1890, by districts.

Districts.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*
First	637,415	630,333	616,819
Second	683,973	681,962	839,696
Third	645,909	579,542	708,770
Total	1,967,297	1,921,837	2,165,285

The product of coal in Tennessee from 1873 to 1890 is shown in the following table:

Coal product of Tennessee from 1873 to 1890.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	350,000	1879	450,000	1885	1,440,957
1874	350,000	1880	641,042	1886	1,714,290
1875	360,000	1881	750,000	1887	1,900,000
1876	550,000	1882	850,000	1888	1,967,297
1877	450,000	1883	1,000,000	1889	1,925,689
1878	375,000	1884	1,200,000	1890	2,169,585

The number of men employed at Tennessee coal mines in 1890 was 4,767, against 4,108 in 1889. Of the number employed in 1890, 175 were convicts.

TEXAS.

Total product in 1889, 128,216 short tons; spot value, $340,617. Total product in 1890, 184,440 short tons; spot value, $465,900.

Although nine counties are reported by the Census Office as producing coal in 1889, in only four of them—Erath, Maverick, Medina, and Webb—is it mined commercially. The other five—Coleman, Jack, McCullough, Rains, and Wise—produced an aggregate of little more than 1,000 short tons. There is nothing to report on the development of coal mines in the State except the increased production of those previously described; the product in 1889 being 38,216 short tons greater than that of the year before and the product of 1890, 55,824 short tons greater than that of 1889. The amount of coal produced in the two years is shown in the following table, together with the distribution and value of the product:

Coal product of Texas in 1889 and 1890.

Distribution.	1889.	1890.
	Short tons.	*Short tons.*
Loaded at mines for shipment	120,602	180,800
Sold to local trade and used by employés	6,552	1,840
Used for steam at mines	1,062	1,800
Total	128,216	184,440
Total value	$340,617	$465,900

UTAH.

Total product in 1889, 236,651 short tons; spot value, $377,456. Total product in 1890, 318,159 short tons; spot value, $552,390.

Coal mining in Utah has been carried on since 1864, but no record of the amount produced was made until 1885, when the product was 213,120 short tons. As yet no thorough geological survey has been made of the coal fields of the Territory, and therefore any reliable estimate of the possibilities of the Territory in the way of future coal production is not practicable. Mr. Ellsworth Daggett contributed an interesting article on the coal fields of Utah to Mineral Resources for 1882, which contains practically all that is known on the subject. During 1888 there was considerable activity in coal mining in Utah, the production increasing 78,940 short tons over the previous year. In 1889 the product decreased 22,310 short tons, but reacted again in 1890 with an increase of 81,508 short tons over 1889.

The most important recent advance in coal mining in Utah has been caused by the opening of the Pleasant Valley No. 1 mine, located at Scofield, Emery county, and operated by the coal department of the Union Pacific Railway Company. The property embraces 1,800 acres of land, on which three coal seams have been opened; the upper 7 feet in thickness, the middle 12 feet, and the lower 28 feet. The mine opened is on the lower seam, and the entire thickness of coal, 28 feet, is taken out, the vein being all clean coal without bone or slate.

The amount, value, and distribution of the coal product of Utah in 1889 and 1890 was as follows:

Coal product of Utah in 1889 and 1890.

Distribution.	1889.	1890.
	Short tons.	*Short tons.*
Loaded at mines for shipment	216,960	279,336
Sold to local trade and used by employés	17,062	13,749
Used for steam at mines	412	1,015
Made into coke	2,217	24,059
Total	236,651	318,159
Total value	$377,456	$552,390

Coal product of Utah from 1885 to 1890.

Years.	Short tons.	Years.	Short tons.
1885	213,120	1888	258,961
1886	200,000	1889	236,651
1887	180,021	1890	318,159

VIRGINIA.

Total product in 1889, 865,786 short tons; spot value, $804,475. Total product in 1890, 784,011 short tons; spot value, $589,925.

The total coal product of Virginia in 1889 was 207,214 short tons less than in 1888. In 1890 it decreased 81,775 tons from 1889. The falling off in 1889 was due partly to the suspension of operations at the Winterpock mines in Chesterfield county. These mines were flooded in 1890 and could not be worked. The Southwest Virginia Improvement Company, the largest operator in the State, also curtailed its output during the year. The following tables exhibit the amount of coal produced in the State during 1889, and 1890 by counties, with the value and distribution of the product:

Coal product of Virginia in 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.	Total number of employés.
	Loaded at mines for shipment on railroad cars.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Buchanan	....	89	80	....	....	169	$345	....
Chesterfield and Henrico	44,648	798	45	3,920	....	49,411	77,692	257
Dickenson	....	23	12	....	....	35	106	....
Lee and Wythe	....	370	....	....	....	370	703	....
Montgomery	3,062	4,642	226	235	....	8,165	19,644	56
Pulaski and Tazewell	685,171	1,062	5,242	3,361	112,210	807,046	705,121	1,242
Russell	....	398	4	....	....	402	603	....
Wise	....	164	24	....	....	188	261	....
Total	732,881	7,546	5,633	7,516	112,210	865,786	804,475	1,555

Coal product of Virginia in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Henrico	19,346	....	....	....	19,346	$24,183	300	24
Chesterfield (*a*)	....	....	....	....	....	....	....	....
Montgomery	2,349	3,140	138	....	5,627	11,400	205	36
Pulaski and Tazewell	586,946	13,862	4,770	153,460	759,038	554,342	298	1,235
Total	608,641	17,002	4,908	153,460	784,011	589,925	(*b*) 296	1,295

a Mines flooded. *b* Average for the State.

All but a very small portion of the coal product of the State comes from the Flat Top region, which has been fully described in previous volumes of Mineral Resources. The "Iron Belt" has added some valuable literature to the subject in a history of the development of this remarkable field, from which the following is abstracted:

"The development in the Flat Top coal field started in the fall of 1881, but only surface work on the side of the mountain was done. In January, 1882, about 20 miners were landed at the point in Tazewell county, Virginia, where now stands the town of Pocahontas, then a howling wilderness, having taken nine days to make the trip from New York, the greater part of this time being consumed in making their way across the mountains from Wytheville. A place was cleared away and a shanty was erected, in which the men cooked their meals and had their sleeping apartments.

"The wet season in the spring of 1882 retarded the progress of the work, which was all out of doors, but in March of that year the first blast was put in the East mine, and on April 1, Mr. Thomas C. Blair, now a successful capitalist of Roanoke, Virginia, closed a contract with the Southwest Virginia Improvement Company to run the No. 1 East mine 1 mile; also the air course and the No. 1 West mine. The work was then pushed with vigor till fall, when it was stopped for a time on account of the inability of the railroad to reach the mines, and in consequence of which all the coal taken from the mine was dumped in front of the opening.

"The New River division of the Norfolk and Western railroad was completed in 1883, and the first carload of the product of the new coal field was shipped through to Norfolk and distributed among the poor. When the car left Pocahontas it was decorated with branches of laurel, and as it passed through the various towns along the route the people, realizing that the completion of the Norfolk and Western branch road to the coal mines would mark the beginning of a new era in the history of our development, in their enthusiasm draped the car with bunting and flags, and when it arrived at Norfolk it was one mass of red, white, and blue.

"When the mines were first opened a shipment of 200 and 300 tons per day was considered a great output, but when the big explosion took place in the year 1884 the daily output was many times greater than this. This explosion was beneficial to the new coal fields, inasmuch as it attracted the attention of the public to it. At that time there were thousands of people in the State who did not know there was such a place as Pocahontas, or had not heard of the wonderful developments going on there.

"In the beginning of 1885 the Norfolk and Western Railroad Company built a branch road from Bluestone Junction which tapped the north side of the Flat Top field. The first to enter this side of the field was the firm of John Cooper & Co. and Messrs. Freeman & Jones. Since the opening of this road the development has been phenomenally rapid.

"The Pocahontas Flat Top coal measures are above the water level, in veins ranging from 5 to to 13 feet in thickness, extending through an area estimated to contain not less than 300 square miles. Pocahontas coal is from the Lower Coal Measures and is semibituminous, containing but 18 per cent. of volatile matter. The veins dip to the north and west, and the extension of the Ohio division of the Norfolk and Western railroad north to the Ohio river and the road west to the Cumberland mountains pass through the Middle and Upper measures, thus opening up coal of greater volatile matter, bituminous, splint, and cannel."

Total shipments over the Norfolk and Western Railroad from 1883 to 1890.

Years.	Short tons.	Years.	Short tons.
1883 (from month of June)	105, 805	1887	1, 169, 700
1884	272, 173	1888	1, 563, 343
1885	651, 987	1889	1, 783, 527
1886	924, 361	1890	1, 814, 568

Part of the above shipments are from the portion of the Pocahontas field which extends into Mercer and McDowell counties, West Virginia. The amounts for the two States are combined in order to show the business of the Flat Top region.

WASHINGTON.

Total product in 1889, 1,030,578 short tons; spot value, $2,393,239. Total product in 1890, 1,263,689 short tons; spot value, $3,426,590.

The production of coal in Washington in 1889 shows a decrease in the amount produced of 185,172 short tons, and in value of $1,254,011 from 1888, which was a year of exceptional activity in the coal-mining industry in Washington. In 1890 the product increased 233,111 short tons in amount over 1889, and $1,133,351 in value.

The following tables show the amount and value of coal produced in Washington in 1889 and 1890, with the distribution of the product:

Coal product of Washington in 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for year 1889.	Total amount received for coal sold in year 1889.	Total employés about mine.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
King	398, 657	3, 121	2, 410	11, 591	....	415, 779	$954, 295	1, 220
Kittitas	289, 300	1, 643	....	3, 758	....	294, 701	777, 450	....
Pierce	228, 889	672	1, 008	4, 049	39, 000	273, 618	578, 493	759
Thurston	39, 200	5, 600	1, 120	560	....	46, 480	83, 000	....
Total	956, 046	11, 036	4, 538	19, 958	39, 000	1, 030, 578	2, 393, 238	*a*2, 657

a Including 678 employés in Kittitas and Thurston counties.

Coal product of Washington in 1890, by counties.

Counties.	Loaded at mine for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*			
King	507, 003	4, 032	12, 086	....	517, 492	$1, 352, 920	292	1, 098
Kittitas	436, 539	2, 518	625	....	445, 311	1, 229, 330	259	489
Pierce	254, 079	10, 699	4, 308	16, 800	285, 886	814, 340	257	589
Thurston	*a* 15, 000	....	....	....	15, 000	30, 000	240	30
Total	1, 212, 621	17, 249	17, 019	16, 800	1, 263, 689	3, 426, 590	(*b*) 270	2, 206

a Prepared coal from lignite.

b Average for the State.

The number of men employed at coal mines in Washington in 1890 was 2,206, against 2,657 the previous year, showing that during 1889 a considerable number were employed in development work, which resulted in an increased product in 1890 while employing less labor. The Census Office reports show that the average wages paid in the State were as follows: Foremen, above ground, $3.76; below ground, $3.97; mechanics, $3.04; laborers, above ground, $2.29; below ground, $2.46; miners, $3.26; boys, from $1 to $1.50.

The following table shows the product of the State for 1887, 1888, 1889, and 1890, by counties:

Product of coal in Washington for four years, by counties.

Counties.	1887.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
King	339,961	546,535	415,779	517,492
Kittitas	104,782	220,000	294,701	445,311
Pierce	229,785	276,956	273,618	285,886
Thurston	15,295	42,000	46,480	15,000
Not specified	82,778	130,259	....	....
Total	772,601	1,215,750	1,030,578	1,263,689

The first discovery of coal in Washington was made in 1852, and the first mine was opened on Bellingham bay in 1854. The coal from this mine was shipped to San Francisco and was the only coal shipped out of the Territory until 1870, when exportation commenced at Seattle, from the Seattle, Renton, and Talbot mines in the vicinity. In 1874 the product from the Seattle mines was 50,000 tons; from July 1, 1878, to July 1, 1879, the product was 155,900 tons. In the year ended December 31, 1879, the product was 137,207 short tons. The Renton mine, opened in 1874, produced, in 1875 and 1876, 50,000, short tons. The Talbot mine, opened in 1875, produced, in 1879, 18,000 short tons of coal. Records of the operations of Washington coal mines are incomplete, and entirely wanting from 1879 to 1884. The mining during this time was confined to King and Pierce counties. During the fiscal year ended June 30, 1885, the total product of the Territory is given at 380,250 short tons, of which King county is credited with 204,480 short tons and Pierce county with 175,770 short tons. The annual product since that time has been as follows:

Product of coal in Washington from 1886 to 1890.

Years.	Short tons.	Years.	Short tons.
1886	423,525	1889	1,030,578
1887	772,601	1890	1,263,689
1888	1,215,750		

WEST VIRGINIA.

Total product in 1889, 6,231,880 short tons; spot value, $5,086,484. Total product in 1890, 7,266,494 short tons; spot value, $6,086,678.

With the exception of a small decrease in 1876, coal mining in West Virginia has shown a continuous growth since 1873, the rate of increase during the last five years being exceptionally rapid. The most notable increase is that in Mercer county, which is a part of the great Flat Top coking coal region, the central point of which is Pocahontas, Virginia, and which embraces the mines at Elkhorn, Simmons, Maybeury, and Goodwill in Mercer and McDowell counties, West Virginia. The product in the West Virginia part of the Flat Top region in 1886 was 328,733 short tons, and in 1890 1,962,092 short tons, showing an increase of 1,633,359 short tons, or nearly 500 per cent. in five years.

The coal fields of West Virginia have been extensively described in previous volumes of Mineral Resources, particularly in the number covering the years 1883-'84.

The following tables show the product for 1889 and 1890 by counties, together with the value and distribution:

Coal product of West Virginia in 1889, by counties.

Counties.	Disposition of total product.					Total product of coal of all grades for 1889.	Total amount received for coal sold in 1889.	Total number of employés.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.	Manufactured into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Barbour	....	1,600	....	....	....	1,600	$1,200	....
Boone	....	2,888	....	....	....	2,888	2,298	....
Braxton	....	160	....	....	....	160	120	....
Brooke	14,035	16,831	103	150	....	31,119	22,828	50
Cabell	....	505	....	....	....	505	485	....
Calhoun	....	220	....	....	....	220	165	....
Clay	....	256	....	....	....	256	192	....
Fayette	1,074,409	12,211	11,468	7,150	345,542	1,450,780	1,302,438	2,644
Gilmer	....	820	....	....	....	820	615	....
Harrison	141,343	26,328	1,200	11	5,233	174,115	114,427	233
Kanawha	1,168,024	31,393	10,614	3,529	4,676	1,218,236	1,166,038	2,484
Lewis	....	60	....	....	....	60	30	....
Lincoln	....	284	....	....	....	284	213	....
Logan	....	3,456	....	....	....	3,456	2,592	....
McDowell	309,489	56,620	4,788	3,265	212,367	586,529	390,232	764
Marion	157,975	24,066	974	1,932	97,520	282,467	199,692	333
Marshall	33,000	14,106	....	600	....	47,706	35,956	72
Mason	83,116	96,844	3,613	1,457	....	185,030	167,783	363
Mercer	750,507	13	4,302	1,858	165,061	921,741	594,885	1,121
Mineral	487,622	3,862	1,924	56	....	493,464	394,827	608
Monongalia	64,927	7,177	438	1,489	....	74,031	53,318	61
Monroe	....	30	....	....	....	30	23	....
Nicholas	....	1,408	....	....	....	1,408	1,056	....
Ohio	28,121	113,615	1,020	414	....	143,170	126,909	204
Pocahontas	....	240	....	....	....	240	180	....
Preston	41,807	3,893	2,156	5,124	76,952	129,932	86,024	239
Putnam	210,214	6,140	1,384	1,014	....	218,752	244,203	451
Raleigh	....	1,480	....	....	....	1,480	1,110	....
Ritchie	....	1,528	36	63	....	1,627	998	....
Taylor	58,318	16,685	837	21	7,651	83,012	52,725	96
Tucker	141,993	538	403	9,235	21,323	173,492	120,574	229
Tyler	....	12	....	....	....	12	9	....
Upshur	....	2,114	....	....	....	2,114	1,586	....
Wayne	....	880	....	....	....	880	660	....
Wetzel	....	264	....	....	....	264	198	....
Total	4,764,900	448,527	44,760	87,368	936,325	6,231,880	5,086,584	9,952

Coal product of West Virginia in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Brooke	16,494	20,130	170	....	36,794	$28,520	202	50
Fayette	1,131,369	28,176	2,839	428,914	1,591,298	1,438,612	225	2,824
Harrison	130,215	9,522	212	4,454	144,408	100,818	194	306
Kanawha	1,380,131	31,001	5,004	4,980	1,421,116	1,365,585	230	2,756
McDowell	595,515	7,414	4,518	348,775	956,222	678,806	183	1,315
Marion	317,931	2,427	4,236	131,134	455,728	313,506	218	865
Marshall	71,031	52,038	....	....	123,669	100,846	265	175
Mason	77,052	(a) 66,562	1,700	....	145,314	134,643	229	480
Mercer	793,841	2,447	1,232	208,350	1,005,870	755,014	217	1,465
Mineral	532,813	40,793	75	....	573,681	501,391	279	620
Monongalia	12,040	10,080	56	9,184	31,360	20,000	260	55
Ohio	[b]50,960	(b) 52,514	112	....	103,586	100,017	268	153
Preston	80,521	2,107	9,400	86,411	178,439	127,808	282	337
Putnam	203,300	838	1,040	....	205,178	198,269	194	375
Taylor	68,841	1,509	....	6,268	76,618	58,159	256	108
Tucker	152,098	10,969	....	82,311	245,378	186,641	309	353
Small mines	....	100,000	....	....	100,000	100,000	....	....
Total	5,614,752	438,527	30,594	1,310,781	7,394,654	6,208,128	(c) 227	12,236

[a] Of this amount 55,265 tons were consumed at the mines for evaporating salt brine.
[b] Of this amount 65,364 tons were used by iron works at or in the vicinity of the mines.
[c] Average for the State.

The coal-producing regions of West Virginia may be said to lie in two nearly parallel lines, one stretching along the northern border of the State from Mineral county on the east to Marion and Monongalia counties on the west, the other following the course of the New and Kanawha rivers through the southwestern portion of the State from its boundaries; the two exceptions to the lines being in the "Panhandle" or extreme northwestern point of the State and in McDowell county in the extreme southern point, a portion of the great Flat Top region. The northern strip embraces the counties of Mineral, Tucker, Preston, Taylor, Harrison, Marion, and Monongalia; the "Panhandle" contains the counties of Ohio, Marshall, and Brooke; and Mason, Putnam, Kanawha, Fayette, and Mercer counties fill out the southern strip. For convenience of description the coal belts are divided into ten districts or regions, as follows: Elk Garden (Mineral county), Upper Potomac (Tucker county), Cheat River (Preston county), Clarksburg (Harrison and Taylor counties), Upper Monongalia (Marion and Monongalia counties), Panhandle (Ohio, Marshall, and Brooke counties), Point Pleasant (Mason county), Kanawha (Putnam and McDowell counties, and part of Fayette), New River (part of Fayette county), Flat Top (McDowell and Mercer counties). The product of West Virginia in 1890, by districts, was as follows:

Coal product of West Virginia in 1890, by districts.

Districts.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Cheat River	80, 521	2, 107	9, 400	86, 411
Clarksburg	199, 056	11, 031	212	10, 722
Elk Garden	532, 813	40, 793	75	....
Flat Top	1, 389, 356	9, 861	5, 750	557, 125
Kanawha	1, 897, 178	35, 103	6, 492	136, 091
New River	817, 622	24, 912	2, 391	297, 803
Pan Handle	(*a*)189, 085	(*a*)124, 682	282	....
Point Pleasant	77, 052	(*b*)66, 562	1, 700	....
Upper Monongalia	329, 971	12, 507	4, 292	140, 318
Upper Potomac	152, 098	10, 969	....	82, 311
Small mines	....	100, 000	....	....
Total	5, 614, 752	438, 527	30, 594	1, 310, 781

Districts.	Total amount produced.	Total value.	Average number of days worked.	Average number employed.	Counties embraced in the districts.
	Short tons.				
Cheat River	178, 439	$127, 803	282	337	Preston.
Clarksburg	221, 021	158, 977	210	413	Harrison and Taylor.
Elk Garden	573, 681	501, 391	279	620	Mineral.
Flat Top	1, 962, 092	1, 433, 319	201	2, 780	McDowell and Mercer.
Kanawha	2, 074, 864	1, 922, 357	229	3, 909	Putnam, Kanawha, and part of Fayette.
New River	1, 142, 728	1, 080, 109	220	2, 046	Part of Fayette.
Pan Handle	264, 049	229, 383	253	378	Ohio, Marshall, and Brooke.
Point Pleasant	145, 314	134, 643	229	480	Mason.
Upper Monongalia	487, 088	383, 505	221	920	Marion and Monongalia.
Upper Potomac	245, 378	186, 641	309	353	Tucker.
Small mines	100, 000	100, 000	......	....	
Total	7, 394, 654	6, 208, 128	(*c*) 227	12, 236	

a Of the Ohio county product 65,364 tons were used by iron works at or in the vicinity of the mines.
b Of this amount 55,265 tons were consumed at the mines for evaporating salt brine.
c Average for the State.

The following table shows the tendency of coal production in West Virginia, by counties, from 1886 to 1890:

Coal production in West Virginia from 1886 to 1890, by counties.

Counties.	1886.	1887.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Brooke	22, 880	40, 366	11, 568	31, 119	36, 794
Fayette	1, 418, 778	1, 126, 839	863, 600	1, 450, 780	1, 591, 298
Harrison	234, 597	154, 220	109, 515	174, 115	144, 403
Kanawha	876, 785	1, 126, 839	863, 600	1, 218, 236	1, 421, 116
McDowell	....	575, 885	961, 395	586, 529	956, 222
Marion	172, 379	365, 844	363, 974	282, 467	455, 728
Marshall	251, 333	92, 368	47, 702	47, 706	123, 669
Mason	150, 878	140, 968	72, 410	185, 030	145, 314
Mercer	328, 733	1, 252, 427	1, 977, 030	921, 741	1, 005, 870
Mineral	361, 312	478, 636	456, 361	493, 464	573, 681
Monongalia	....	....	....	74, 031	31, 360
Ohio	(*a*)	131, 936	140, 019	143, 170	103, 586
Preston	170, 721	276, 224	231, 540	129, 932	178, 439
Putnam	(*b*)	53, 200	145, 440	218, 752	205, 178
Taylor	(*c*)	168, 000	55, 729	83, 012	76, 618
Tucker	22, 400	24, 707	62, 517	173, 492	245, 378
Other counties and small mines	....	....	....	18, 304	100, 000
Total	4, 005, 796	4, 881, 620	5, 498, 800	6, 231, 880	7, 394, 654

a Included in product of Marshall county.
b Included in product of Mason county.
c Included in product of Harrison county.

The annual increase in the production of coal in West Virginia (with the exception previously noted) may be seen from the following statement:

Coal product of West Virginia from 1873 to 1890.

Years.	Short tons.	Years.	Short tons.
1873	672,000	1882	2,240,000
1874	1,120,000	1883	2,335,833
1875	1,120,000	1884	3,360,000
1876	896,000	1885	3,369,062
1877	1,120,000	1886	4,005,796
1878	1,120,000	1887	4,881,620
1879	1,400,000	1888	5,498,800
1880	1,568,000	1889	6,231,880
1881	1,680,000	1890	7,266,494

WYOMING.

Total product in 1889, 1,388,947 short tons; spot value, $1,748,617. Total product in 1890, 1,870,366 short tons; spot value, $3,183,669.

The product of coal in Wyoming in 1889 was 92,593 short tons less than in 1888. The output in 1890 was 481,419 short tons more than in 1889. The following tables show the amount produced in the State in 1889 and 1890, by counties, with the value and distribution of the product:

Coal product of Wyoming in 1889, by counties.

Counties.	Disposition of total product.				Total product of coal of all grades for year 1889.	Total amount received for coal sold in year 1889.	Total employés about mines.
	Loaded at mines for shipment on railroad cars and boats.	Sold to local trade at mines.	Used by employés.	Used for steam at mines.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Carbon	193,402	1,501	1,073	3,300	199,276	$194,817	488
Converse	16,285	553	305	250	17,393	30,955	....
Crook	....	200	....	....	200	600	....
Johnson	2,300	2,742	50	....	5,092	13,257	....
Sheridan	....	510	45	....	555	840	....
Sweetwater	843,668	....	3,368	10,177	857,213	1,025,067	1,441
Uinta	298,788	1,824	3,262	5,344	309,218	483,081	....
Total	1,354,443	7,330	8,103	19,071	1,388,947	1,748,617	(a)2,675

a Including 746 employés in Converse, Crook, Johnson, and Uinta counties.

Coal product of Wyoming in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*		
Carbon	302,106	1,785	2,078	305,969	$535,460	714
Converse	23,345	1,603	800	25,748	44,696	30
Fremont	900	500	....	1,400	5,750	4
Johnson	7,275	195	....	7,470	16,984	12
Sheridan	400	250	....	650	975	2
Sweetwater	974,533	3,994	300	978,827	1,666,068	(a)1,672
Uinta	341,716	5,213	3,349	350,278	628,806	422
Weston	185,024	15,000	....	200,024	289,930	416
Total	1,835,299	28,540	6,527	1,870,366	3,183,669	3,272

a Including 250 Chinese.

The following information regarding the production of coal in Wyoming in 1890 by counties, and the comparative tables in connection therewith, have been compiled by Mr. F. F. Chisolm, special agent for the Rocky Mountain region:

CARBON COUNTY.

Total product in 1890, 305,969 short tons; spot value, $535,460. This does not include nut coal and slack coal from Union Pacific mines, as no account is kept.

Although all the various openings made at the Carbon mines have been abandoned, except No. 2 and No. 5, and the output smaller in 1890 than in any year since 1882, except 1889, nearly two-thirds of the production in 1890 came from Carbon, the combined output from the New Hanna No. 1 and No. 2 mines and the Dana No. 1 mine being less than half that from the Carbon mines.

The Carbon mines have been fully described in previous volumes of the Mineral Resources. The product of coal from these mines to date has been:

Product of the Carbon mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1880	100,433
1869	30,482	1881	156,820
1870	54,915	1882	200,123
1871	31,748	1883	248,380
1872	59,237	1884	319,883
1873	61,164	1885	226,863
1874	55,880	1886	214,233
1875	61,750	1887	288,358
1876	69,060	1888	338,947
1877	74,343	1889	178,832
1878	62,418	1890	201,191
1879	75,424		

The newly opened Hanna No. 1 and Hanna No. 2 mines of the Union Pacific railway at Hanna, on the Carbon cut-off, practically began production in 1890, the output for the year being 74,757 short tons. These two mines will probably be steady and large producers, in part supplying the increasing demands of the Union Pacific for locomotive use and also for commercial purposes in Nebraska and Kansas. The coal is very similar in character to the Carbon coal. The machinery and equipment of these mines is excellent, but coal-cutting machines are not used.

The Dana No. 1 mine, at Dana Station, began commercial production in 1889, and is described on page 329 of the Mineral Resources for 1888. The output in 1890 was 29,886 short tons. It is commonly reported that the coal from this mine has not equaled the expectations of the Union Pacific Railway Company, to which may be due the small production in 1890. It should be specially noted that the stated product of all mines operated by the coal department of the Union Pacific does not include the nut or slack produced, these sizes being practically unsalable, and no satisfactory statement of the amounts produced being obtainable.

Near Rawlins two new coal mines are growing in importance as coal producers, the Dillon mine operated by the Dillon Coal Company, and the Merrill mine operated by the Rawlins Coal Company. At various points in Carbon county the small local trade is supplied by individual operators from the Bessemer, Clyde, Fly, Reeder, Gumerson, Cronkhite, and Savory mines. The coal of the Seminoe district is yet without a railway, though the building of the Carbon cut-off from Carbon to Hanna has brought it within 25 miles of railroad transportation.

Analyses of coals from Seminoe, Wyoming.

	No. 1.	No. 2.	No. 3.	No. 4.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	10.70	9.10	9.40	8.52	9.43
Volatile matter	45.15	45.23	39.60	49.30	44.82
Fixed carbon	35.05	37.06	47.40	38.97	39.62
Ash	9.10	8.61	3.60	3.21	6.13
Total	100.00	100.00	100.00	100.00	100.00
Total fuel	88.20	82.29	87.00	88.27	84.69
Sulphur	0.93	0.66	0.52	0.37	0.62

The following analyses, made by Prof. L. D. Ricketts, show the composition of the coals from the Dana Nos. 1 and 2, the Hanna 1 and 2, the Dillon, Merrill, and Cronkhite mines in Carbon County:

Analyses of some Carbon county coals, Wyoming.

	Dana No. 1.	Dana No. 2.	Hanna No. 1.	Hanna No. 2.	Cronkhite.	Dillon.	Dillon.	Merrill.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Water	11.70	11.30	8.67	9.52	9.20	7.47	5.19	19.16
Volatile matter	41.41	42.01	45.05	41.85	34.40	36.05	37.05	33.11
Fixed carbon	39.65	39.69	41.91	44.68	52.40	51.56	48.50	41.07
Ash	7.24	7.00	4.71	3.92	2.80	4.32	9.25	3.64
Total	100.00	100.00	100.44	99.97	98.80	99.40	99.99	96.98

CONVERSE COUNTY.

Total product in 1890, 25,748 short tons; spot value, $44,696.

The coal output of Converse county in 1890 came from the Douglas mine, at Douglas; the Fetterman mine, at Inez, and the Deer Creek mine at Glenrock. At the latter mine the Deer Creek Coal Company has put in Harrison coal-mining machines.

FREMONT COUNTY.

The total product in 1890 amounted to 1,400 short tons, valued at $5,750, which came from the Lone Star and Gillis mines. This is the first product of coal reported from Fremont county.

JOHNSON COUNTY.

Total product in 1890, 7,470 short tons; spot value, $16,984. The coal mined in Johnson county was taken from four mines, the Buffalo and Vulcan, of the Buffalo Fuel Company, the Diamond, of the Diamond Coal Company, and the Holland, operated by Mr. W. H. Holland. These mines supply the local trade at and near Buffalo. The Buffalo mine shows a 7-foot vein of good lignite, and the Diamond a 6-foot vein. At various points in this county veins of coal varying from 3 to 14 feet in thickness outcrop and some small amount is taken from them by ranchmen for their own use as fuel, but no estimate of the total mined in this way is included in the statement of production. The prospects for railway connection with Buffalo, the only town in the county, are bright, and with transportation facilities the growth of coal production in Johnson county will be rapid.

SHERIDAN COUNTY.

The total product of Sheridan county in 1890 was 650 short tons, valued at $975, against 550 short tons, valued at $840, in 1889. There were no developments of any interest during the two years.

SWEETWATER COUNTY.

Total product in 1890, 978,827 short tons; spot value, $1,666,068. (*a*)

The mines worked by the Coal Department of the Union Pacific Railway Company, the Van Dyke Coal Company, the Rock Spring Coal Company, and the Hopkins Coal Company have been fully described in previous volumes of the Mineral Resources.

There were in 1890 no developments of note among the coal mines, and only one new coal mining corporation of importance has been organized since the Mineral Resources for 1888 was issued. This corporation, the Sweetwater Coal Mining Company, owns a very large body of coal land lying near Rock Spring and south of the Union Pacific railway and began production practically in 1890.

The Coal Department of the Union Pacific Railway Company has mined from the Rock Spring field the tonnage given in the following table:

Product of the Rock Spring mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	305	1880	244,460
1869	16,933	1881	270,425
1870	20,945	1882	287,510
1871	40,566	1883	304,495
1872	34,677	1884	318,197
1873	44,700	1885	328,601
1874	58,476	1886	359,234
1875	104,664	1887	465,444
1876	134,952	1888	662,277
1877	146,494	1889	777,213
1878	154,282	1890	652,406
1879	198,252		

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a Not including nut coal and slack coal from Union Pacific mines, of which no account is kept.

Following are some analyses of Sweetwater county coals, made by Prof. Ricketts:

Analyses of Sweetwater county, Wyoming, coals.

	Van Dyke.	Number 4.	Blair No. 1.	Hopkins.	Blair No. 2.	Number 7.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	8.86	9.05	7.51	6.70	7.08	9.22
Volatile matter	39.15	40.00	39.06	39.30	38.54	38.78
Fixed carbon	49.13	48.87	50.22	51.27	52.63	49.52
Ash	2.86	2.08	2.59	2.72	1.75	2.48

UINTA COUNTY.

Total product in 1890, 350,278 short tons; spot value, $623,806. This does not include nut coal and slack coal from Union Pacific mines, as no account is kept.

The coal output of Uinta county is made by but two corporations, the Coal Department of the Union Pacific Railway Company and the Rocky Mountain Coal and Iron Company. There are in all ten openings made by these two companies, eight of which are on the east of Bear river and contiguous. Of these the Union Pacific owns the Almy Nos. 1, 2, 3, 5, and 8, all of which have been abandoned except No. 8, while the Rocky Mountain Company own the Almy Nos. 6 and 7, and also a little further north two new mines, the Red Cañon No. 1 and No. 2.

The product of the Union Pacific mines to January 1, 1891, has been as follows:

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1,967	1880	100,234
1870	12,454	1881	110,157
1871	21,171	1882	117,211
1872	22,713	1883	111,713
1873	22,847	1884	150,880
1874	23,006	1885	164,441
1875	41,805	1886	155,547
1876	60,756	1887	196,913
1877	54,643	1888	160,035
1878	59,096	1889	118,629
1879	71,576	1890	176,130

Since the date of opening, the Rocky Mountain Coal and Iron Company has produced up to January 1, 1891, the following tonnage of coal:

Product of the Rocky Mountain Coal and Iron Company's mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1870	16,961	1881	90,779
1871	53,843	1882	94,065
1872	105,118	1883	78,450
1873	130,989	1884	68,471
1874	181,699	1885	70,216
1875	92,589	1886	100,341
1876	69,782	1887	164,519
1877	67,373	1888	209,298
1878	57,404	1889	190,589
1879	60,739	1890	170,798
1880	82,684		

Both properties have been fully described in previous volumes of the Mineral Resources.

WESTON COUNTY.

Total product in 1890, 200,024 short tons; spot value, $289,930.

The most remarkable developments in the history of coal mining in Wyoming were made at Newcastle mines, the Antelope and Jumbo, located at Cambria, six miles north of Newcastle, Weston county, and operated by the coal department of Kilpatrick Brothers and Collins.

The coal found here probably occurs in the lowest portion of the Dakota measures of the Colorado Cretaceous and almost upon the topmost rocks of the Jurassic, but not, as often stated, within the Jurassic rocks. The influence of the eruptive upthrust of the Black Hills is shown by the local dip of the stratification, which averages about 22 degrees, the direction of the dip being nearly parallel to a line drawn from Harney Peak to Cambria, or about northeast by southwest, but this inclination of the sedimentary rocks is not constant in degree or direction, but varied by the eruptive outflow, not connected with the Harney Peak mass, such as the Inyan Kara butte to the north.

The vein of coal worked at Cambria is from 6½ to 7½ feet in thickness, with good roof and floor.

Regarding the character of the coal, there is a considerable diversity of opinion, and it has been classed from lignite to a high-grade coking bituminous coal. This difference may be due, in part, to actual variations caused by partial metamorphism by heat. It is sufficient to say that under the test of actual use it gives satisfaction, and that it is claimed by the operators to be a good coking coal. The coke produced is apparently of a good quality, quite dense, and capable of sustaining any weight ordinarily required of coke. The coke, however, as at present produced, runs a trifle too high in ash to be valuable for all uses.

The two mines worked are separated by a narrow cañon, through which the railway spur track to the mines is built, the main entries being on opposite sides and from 60 to 70 feet above the railway tracks. The tipples and chutes are connected with the entries by short trestles substantially built. The daily capacity of the mines is about 2,000 tons, and the product is sold largely to the railroad company.

All of the openings are made with a view to large and regular production, and their entries and rooms are lighted by electricity. The machinery and appliances are of the best modern type and the entire equipment admirable.

Several coal mines in this section have been slightly developed by other corporations and individuals, but as yet the production from these has been small.

The production of coal from the beginning of coal mining to January 1, 1891, is given in the following table:

Total product of coal in Wyoming, by counties.

Years.	Carbon county.	Sweetwater county.	Uinta county.	Weston county.	Converse county.	Other counties.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1868	6,560	365	....	....	....	....	6,925
1869	30,482	16,933	1,967	....	....	....	49,382
1870	54,915	20.945	29,435	....	....	....	105,295
1871	31,748	40,566	75,014	....	....	....	147,328
1872	59,237	34,677	127,831	....	....	....	221,745
1873	61,164	44,700	153,836	....	....	....	259,700
1874	55,880	58,476	104,705	....	....	....	219,061
1875	61,750	104,664	134,394	....	....	....	300,808
1876	69,060	134,952	130,538	....	....	....	334,550
1877	74,343	146,494	122,016	....	....	....	342,853
1878	62,418	154,282	116,500	....	....	....	333,200
1879	75,424	193,252	132,315	....	....	....	400,991
1880	100,433	244,460	182,918	....	....	....	527,811
1881	156,820	270,425	200,936	....	....	....	628,181
1882	200,123	287,510	211,276	....	....	8,855	707,764
1883	248,380	304,495	190,163	....	....	36,651	779,689
1884	319,883	318,197	219,351	....	....	45,189	902,620
1885	226,863	328,601	234,657	....	....	17,207	807,328
1886	214,233	359,234	255,888	....	....	....	829,355
1887	288,358	465,444	361,423	....	....	55,093	1,170,318
1888	338,947	732,327	369,333	....	29,933	11,000	1,481,540
1889	199,276	857,213	309,218	....	17,393	5,847	1,388,276
1890	305,969	978,827	350,278	200,024	25,748	9,520	1,870,366
Total	3,242,266	6,007,039	4,013,992	200,024	73,074	189,362	13,825,096

PETROLEUM.

By Joseph D. Weeks.

LOCALITIES IN THE UNITED STATES IN WHICH PETROLEUM IS FOUND.

While petroleum has been found in nearly every State and Territory, the localities in which it is produced in quantity are but few. These are the well-known oil regions of western Pennsylvania and New York, the Turkey Foot and other districts of West Virginia, the Macksburg and Lima fields in Ohio, the Florence district of Colorado, and the oil fields of southern California. Practically, all the petroleum produced in the United States is from the districts named, though a few thousand barrels were produced in Indiana, Kentucky, Illinois, Kansas and Texas in 1889 and 1890.

Not only are the localities named above the chief petroleum producing districts in the United States, but the indications are that, with the possible exception of Wyoming, they will continue so to be. The Indiana field has some promise, and may be a producer of some importance in the future. The Kentucky and other southern oil fields, which at one time it was supposed would be factors of some importance in the oil production of the United States, give at the present time no such indication. The Illinois field is an exceedingly small one, with but little promise for the future, while the Kansas and Texas fields will at the best probably produce only a few thousand barrels each year of a high-grade lubricating oil. However, there have been so many surprises in petroleum that these statements must be regarded as only setting forth the present indications.

A notable feature of the production in the United States in 1890 was the great increase in production which is manifest in nearly all of the districts. The production of the United States increased from 35,163,513 barrels in 1889 to 45,822,672 barrels in 1890.

The production of Pennsylvania and New York increased from 21,487,435 barrels to 28,458,208 barrels. This increased production was chiefly in what is known as the Southwest district, including Allegheny, Washington, Beaver and Greene counties. The McDonald production had not yet begun in 1890.

The production of Ohio increased from 12,471,466 barrels to 16,124,656 barrels in 1890. This increase was in both the Lima and Macksburg districts.

The production of West Virginia decreased slightly. Indiana very nearly doubled its production. There was a slight increase in both Colorado and California, while the other States about maintained their position.

Character and composition of American petroleum.—While the petroleum from different wells in the same district usually differs but little in character, there is a marked variation in many cases in the oils from different districts. The most notable distinction is in the solid constituents of the oil. The "basis" of all the petroleums in the United States, except a portion of those found in the southern part of California, is paraffin; of those of southern California, in most cases, asphalt.

In most of the oils a varying quantity of the lighter hydrocarbons, known in a general way as naphtha, is found. In others these lighter products are almost entirely wanting, or at least in refining all of the distillate is sold as illuminating oil. The composition of certain oils is also such that a large amount of lubricating oil, or heavy oils adapted to lubricating, is produced. For example, the Kansas and Texas oils are natural lubricating oils and can be used without any preparation except straining to remove any grit, while other so-called natural lubricating oils have to be prepared by a process of distillation, the various grades of density being used for various kinds of lubrication.

It may be said in a general way that the products of petroleum are naphthas or the lighter hydrocarbons, illuminating oils, heavy oils or lubricants, residuum, paraffin or asphalt, and water.

Regarding the oils of western Pennsylvania, New York, West Virginia and the Macksburg district of Ohio, which are chiefly used for the production of illuminating oil, it may be said that the petroleums of these districts as they come from the ground are clear, semitransparent oils, generally of an amber color, but varying somewhat in this regard with their density. When allowed to stand, however, a thick emulsion, reported in the tables of stocks, as "B. S." or sediment, separates itself from the oil. The amount of this sediment varies greatly, the longer the oil is allowed to stand the greater being the proportion of "B. S.," and the less the proportion of the lighter hydrocarbons. It is for this reason that fresh oil, or oil just produced, commands a premium over old oil, or that which had been allowed to stand in tanks, its yield of the lighter hydrocarbons, and of the better grades of illuminating oil, being greater when fresh than after having been stored.

The percentages of the products of fresh oil in refining will depend largely upon the methods of refining. This can be carried on so as to make the product of heavy oils almost nothing. From a refinery in western Pennsylvania the following statement as the result of their operations for two years has been received:

Percentage of products from Pennsylvania petroleum.

Products.	Per cent.	Per cent.
Naphthas	10.34	10.89
Illuminating oils	75.00	78.20
Heavy oils	2.00 to 6.00	2.00 to 4.00
Residuum	4.05	2.86
Water and loss	5.00 to 8.00	5.00 to 8.00

But little Lima or, better, Trenton limestone oil produced in western Ohio and eastern central Indiana had been refined in a commercial way prior to 1889. The chief obstacle to this use of the oil was the difficulty of removing the sulphur compounds present in it and the small percentage of illuminating oil which could be produced from the crude. At least two refineries succeeded in overcoming the difficulties in the way of the sulphur compounds during 1889, and American Trenton limestone oil became a factor in the market to some extent and promises to be a much more important one in the future. The actual facts, however, as to the yield of different products from this oil have been very difficult to obtain. In a general way it may be said to yield a comparatively large percentage of the lighter products and a small percentage of illuminating oil. In general conversation it is customary to assume a yield of 22 per cent. in illuminating oils and 15 per cent. of naphtha.

In a recent number of the Journal of the American Chemical Society appeared an analysis of Lima petroleum, made in the laboratory, however, which shows a yield as follows:

Products from Lima, Ohio, petroleum.

	Per cent.
Naphtha, at 70° Baume	16
Burning oil	68
Paraffin oils	6
Solid residuum	10
Total	100

These results are never reached in actual practice. Another sample of Lima petroleum gave the following results:

Products from Lima, Ohio, petroleum.

	Per cent.
Distillate at 59° Baume	13.75
Distillate at 75° Baume	35.11
Distillate at 39° Baume	7.93
Distillate at 36.5° Baume	13.40
Distillate at 36° Baume	18.60
Residuum	9.65
Water	0.70
Total	99.14

The foregoing would indicate a production of oils approximately as follows:

Products from Lima, Ohio, petroleum.

	Per cent.
Naphtha and burning oil	56.80
Heavy oils	32.00
Residuum	9.60
Water	0.70
Sulphur, first determination	0.63
Sulphur, duplicate	0.68
Sulphur, average	0.65
Total	99.75

The petroleum from the Florence oil fields in Colorado seems to be lacking in the lighter hydrocarbons or naphthas, or at least in refining it all of the distillate is sold as illuminating oil, the whole product of refining being divided only into two classes, illuminating oil and residuum. It yields in refining from 34 to 44 per cent. of this illuminating oil of about 125° fire test. This oil contains no "B. S."

As has already been pointed out, most of the oil of southern California differs from that of all other sections of the country in having asphaltum as its base instead of paraffin. The oils from the different fields of this section also differ greatly in their character, some being practically liquid bitumens, yielding a very small amount of illuminating oils on distillation, while others have less asphaltum, producing larger percentages of illuminating oil. Here, also, the results of distillation are only two, one illuminating oil, of which about 35 per cent. is produced from the crude charge, the other residuum, which is sold for fuel.

The approximate classification of the distillates of California oil, as given by Mr. Durand Woodman in the Journal of the American Chemical Society, is as follows:

Products from California petroleum.

	Per cent.
Naptha under 0.73 specific gravity	10 +
Illuminating oils	40 ±
Lubricating oils	40 ±
Residuum	10 +
Sulphur	0.18
Water	0.27
Paraffin	None separable.

TOTAL PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES.

In the following table will be found a statement of the total production of crude petroleum of all grades in the United States in 1889 and 1890. It should be stated here, once for all, that the statistics and much of the text concerning the year 1889 are taken from the report made by the writer to the Eleventh Census:

Production of petroleum in the United States in 1889 and 1890.

States.	1889.	1890.
	Barrels. (*a*)	*Barrels.* (*a*)
Pennsylvania and New York	21,487,435	28,458,208
Ohio	12,471,466	16,124,656
West Virginia	544,113	492,578
Colorado	316,476	368,842
California	303,220	307,360
Indiana	33,375	63,496
Kentucky	5,400	6,000
Illinois	1,460	....
Kansas	500	1,200
Texas	48	54
Missouri	20	278
Total	35,163,513	45,822,672

a 42 gallons.

In this table the production of Pennsylvania and New York is united. The Bradford (Pennsylvania) field extends into Cattaraugus county, New York, and is so closely connected with the Allegany county (New York) field as to cause them to be regarded as one in most reports. It will probably be approximately correct to estimate that 26.5 per cent. of this was produced in New York, 8.5 per cent. being from Cattaraugus county, and 18 per cent. from Allegany county; this would make the production in 1889 of New York 1,896,966 barrels, and of the Pennsylvania portion of this district 5,261,397 barrels. The production of Cattaraugus county, New York, assuming this estimate to be correct, was 608,461 barrels, and of Allegany county, New York, 1,288,505 barrels.

In the following table will be found consolidated the statistics of the production of petroleum in the United States from the beginning of operations in these fields, so far as the same could be ascertained:

Product of crude petroleum in the United States from 1859 to 1890. (a)

[Barrels of 42 gallons.]

Years.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.	Total United States.
1859..	2,000	....	....	....	....	......	....	......	......	...	...	2,000
1860..	500,000	....	....	....	....	......	....	......	......	...	...	500,000
1861 .	2,113,609	....	....	....	....	......	....	......	......	...	...	2,113,609
1862..	3,056,690	....	....	....	....	......	....	......	......	...	...	*b* 3,056,690
1863..	2,611,309	....	....	....	....	......	....	......	......	...	...	2,611,309
1864..	2,116,109	....	....	....	....	......	....	......	......	...	...	2,116,109
1865..	2,497,700	....	....	....	....	......	....	......	......	...	...	2,497,700
1866..	3,597,700	....	....	....	....	......	....	......	......	...	...	3,597,700
1867..	3,347,300	....	....	....	....	......	....	......	......	...	...	3,347,300
1868..	3,646,117	....	....	....	....	......	....	......	......	...	...	3,646,117
1869..	4,215,000	....	....	....	....	......	....	......	......	...	...	4,215,000
1870..	5,260,745	....	....	....	....	......	....	......	......	...	...	5,260,745
1871..	5,205,234	....	....	....	....	......	....	......	......	...	...	5,205,234
1872..	6,293,194	....	....	....	....	......	....	......	......	...	...	6,293,194
1873..	9,893,786	....	....	....	....	......	....	......	......	...	...	9,893,786
1874..	10,926,945	....	....	....	....	......	....	......	......	...	...	10,926,945
1875..	8,787,514	*d* 200,000	*d* 3,000,000	....	*d* 175,000	......	....	......	......	...	...	*c* 12,162,514
1876..	8,968,906	31,703	120,000	....	12,000	......	....	......	......	...	...	9,132,669
1877..	13,135,475	29,888	172,000	....	13,000	......	....	......	......	...	...	13,350,363
1878..	15,163,462	38,179	180,000	....	15,227	......	....	......	......	...	...	15,396,868
1879..	19,685,176	29,112	180,000	....	19,858	......	....	......	......	...	...	19,914,146
1880..	26,027,631	38,940	179,000	....	40,552	......	....	......	......	...	...	26,286,123
1881..	27,376,509	33,867	151,000	....	99,862	......	....	......	......	...	...	27,661,238
1882..	30,053,500	39,761	128,000	....	128,636	......	*e* 160,933	......	......	...	...	*e* 30,510,830
1883..	23,128,389	47,632	126,000	....	142,857	......	4,755	......	......	...	...	23,449,633
1884..	23,772,209	90,081	90,000	....	262,000	......	4,148	......	......	...	...	24,218,438
1885..	20,776,041	650,000	91,000	....	325,000	......	5,164	......	......	...	...	21,847,205
1886..	25,798,000	1,782,970	102,000	....	377,145	......	4,726	......	......	...	...	28,064,841
1887..	22,356,193	5,018,015	145,000	76,295	678,572	......	4,791	......	......	...	...	28,278,866
1888..	16,488,668	10,010,868	119,448	297,612	690,333	......	5,096	......	......	...	...	27,612,025
1889..	21,487,435	12,471,466	544,113	316,476	303,220	33,375	5,400	1,460	500	48	20	35,163,513
1890..	28,458,208	16,124,656	492,578	368,842	307,360	63,496	6,000	......	1,200	54	278	45,822,672
Total	396,746,754	46,637,198	5,820,139	1,059,225	3,590,622	96,871	201,013	1,460	1,700	102	298	454,155,382

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a Some oil was produced in other States, but no record has been secured other than that contained in note *b*.

b In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee.

c Including all production prior to 1876 in Ohio, West Virginia, and California.

d Includes all production prior to 1876.

e This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

PRODUCTION AND VALUE OF CRUDE PETROLEUM IN THE UNITED STATES IN 1889, ACCORDING TO USES.

In the following table are shown, by States, the production, total value, and value per barrel of the petroleum produced in the United States in 1889 according to uses, as compiled for the Census Office:

Production, value, etc., of crude petroleum in 1889, by States.

States.	Illuminating.			Lubricating.		
	Production.	Value.	Average per barrel.	Production.	Value.	Average per barrel.
	Barrels.			*Barrels.*		
Pennsylvania and New York	21,393,159	$23,225,453	$1.08⅝	94,276	$249,710	$2.64⅞
Ohio	317,037	340,683	1.07½	1,240	10,334	8.33⅜
West Virginia	520,511	595,730	1.14½	23,602	58,097	2.46⅛
Colorado	316,476	280,240	0.88½			
California	97,264	121,684	1.25⅛			
Indiana						
Kentucky	5,400	5,400	1.00			
Illinois				1,460	4,906	3.36
Kansas				500	2,500	5.00
Texas				48	340	7.08⅜
Missouri				20	40	2.00
Total	22,649,847	24,569,190	1.08½	121,146	325,927	2.69

States.	Fuel.			Total.		
	Production.	Value.	Average per barrel.	Production.	Value.	Average per barrel.
	Barrels.			*Barrels.*		
Pennsylvania and New York				21,487,435	$23,475,163	$1.09¼
Ohio	12,153,189	$1,822,978	$0.15	12,471,466	2,173,995	0.17⅜
West Virginia				544.113	653,827	1.20⅛
Colorado				316,476	280,240	0.88½
California	205,956	234,364	1.13¾	303,220	356,048	1.17⅜
Indiana	33,375	10,881	0.32⅝	33,375	10,881	0.32⅝
Kentucky				5,400	5,400	1.00
Illinois				1,460	4,906	3.36
Kansas				500	2,500	5.00
Texas				48	340	7.08⅜
Missouri				20	40	2.00
Total	12,392,520	2,068,223	0.16¾	35,163,513	26,963,340	0.76⅝

It should be said, in explanation of the preceding table, that the classification is according to uses for which the oil was intended. That classified as illuminating oil includes that production usually sold and delivered to refineries for making into illuminating oil, but in connection with this manufacture there is a certain amount of lighter products, such as benzine, as well as, when it is so desired, a certain amount of lubricating oil, and also of residuum, which may be used as fuel. Under the head of "Fuel" is included the production from those districts the oil of which is used chiefly for fuel purposes, though a small portion of this oil was used in 1889 for the manufacture of illuminating oil, and much larger amounts since. Under the head of "Lubricating" are included only what are known as the natural lubricating oils, which are used only as lubricators, either without any preparation or with slight refining. From this table it will be noticed that the total production of what is classed as illuminating oil in the United States in 1889 was 22,649,847 barrels, valued at $24,569,190, an average value of $1.08½ per barrel. The product of lubricating oil was 121,146 barrels, valued at $325,927, or $2.69 per barrel. The production of what is classed as fuel oil was 12,392,520 barrels, valued at $2,068,223, or 16⅔ cents per barrel. With the exception of 205,956 barrels produced in California, all of the fuel oils, so called, produced in the United States were from the Trenton limestone oil fields in Ohio and Indiana. The total production of all grades of oil in the United States was 35,163,513 barrels, valued at $26,963,340, or 76⅔ cents per barrel.

STOCKS OF CRUDE PETROLEUM.

The stocks of crude petroleum held in tanks at the wells in the United States on December 31, 1888 and 1889, as well as the total production for December, 1888, and December, 1889, are given in the following table. In the States other than Pennsylvania, Ohio and West Virginia these stocks at the wells represent all the stocks of crude petroleum held by producers or for them. In Pennsylvania, Ohio and West Virginia to these stocks at the wells should be added the stocks held by the pipe-line companies. Even this total will not represent the amount of crude petroleum in the country, but only that held by the producer or the party who has purchased the oil from him which is still carried in the tanks of the pipe-line companies. The crude petroleum held by the refiners is not included in the statement.

The table of stocks on hand December 31, 1888 and 1889, is as follows:

Production and well stocks of crude petroleum in 1888 and 1889, by States.

States.	1888.			1889.		
	Production, December.	Stock on hand at wells December 31.	Per cent. of stock at wells, production.	Production, December.	Stock on hand at wells December 31.	Per cent. of stock at wells, production.
	Barrels.	*Barrels.*		*Barrels.*	*Barrels.*	
Pennsylvania and New York	1,582,741	339,187	21.43	2,055,247	423,336	20.60
Ohio	1,070,746	81,224	7.59	971,538	470,125	48.39
West Virginia	19,060	6,104	32.03	81,453	6,835	8.39
Colorado	25,769	13,092	50.81	34,570	51,034	147.63
California	28,671	7,547	26.32	25,737	3,440	13.37
Indiana				[a]2,730	12,250	448.72
Kentucky				[a]450		
Illinois	[a]120	110	91.67	[a]120	100	83.33
Kansas	[a]42	100	238.10	[a]42	100	238.10
Texas	[a]4	6	150.00	[a]4	48	1,200.00
Missouri	[a]1			[a]2		
Total	2,727,154	447,370	16.40	3,171,893	967,268	30.49

[a] Average per month for the year.

From this table it appears that out of a total production in the United States of 2,727,154 barrels in December, 1888, 447,370 barrels, or 16.40 per cent. was carried in stock at the wells on December 31, 1888, while of a production of 3,171,893 barrels in December, 1889, 967,268 barrels, or 30.49 per cent. was carried in stock at the wells. It will be noted that at the close of December, 1888, stocks carried at the wells of Pennsylvania amounted to 21.43 per cent. of the total production, and at the close of December, 1889, 423,336 barrels, or 20.60 per cent. was carried in stock at the wells. In Ohio but 7.59 per cent. of the production of December, 1888, was carried at the wells at the close of that month, while 48.39 per cent. of the production of December, 1889, was so carried. The other figures are of but little importance.

The stock of crude petroleum carried by the pipe lines in Pennsylvania and New York at the close of December, 1888, was 18,995,814 barrels. On December 31, 1889, this had decreased to 11,562,593 barrels. The stock held by the pipe lines in Ohio at the close of December, 1888, was 10,161,842 barrels. At the close of December, 1889, this had increased to 14,415,997 barrels, making a total stock held by the pipe lines at the close of December, 1888, of 29,157,656 barrels, and at the close of December, 1889, of 25,978,590 barrels. Adding these amounts to the stocks carried at the wells, there would be a total of 29,605,026 barrels in stock December 31, 1888, and 26,945,858 barrels on December 31, 1889.

CENSUS STATISTICS OF WAGES.

Concerning the different rates of wages paid foremen, pumpers or engineers, and drillers, shown in the various tables of classified wages that will appear through this report, it should be noted that a pumper or engineer may operate a number of wells and the lowest rate given may be for one well and highest rate for a group of wells. A similar remark will apply to the wages of foremen.

The statistics of labor and wages in the production of crude petroleum in the United States in 1889, by States, are as follows:

Total number of employés and number of each class and wages paid.

States.	Number of employés.	Total wages.	Foremen.		Mechanics.	
			Number.	Wages.	Number.	Wages.
Pennsylvania and New York	19,832	$7,423,781	1,230	$744,674	10,049	$3,742,416
Ohio	2,123	836,377	94	71,613	724	235,607
West Virginia	339	160,974	17	14,520	213	108,298
Colorado	90	34,632	5	4,950	56	19,138
California	95	75,056	5	8,000	25	18,147
Indiana	34	6,080	1	1,200	7	725
Kentucky	14	3,050	2	1,248	8	660
Illinois	1	600				
Kansas	10	6,000			2	1,000
Missouri	1	350				
Total	22,539	8,546,900	1,354	846,205	11,084	4,125,991

Total number of employés and number of each class and wages paid—Continued.

States.	Laborers.		Boys under 16.		Office force.			
					Males.		Females.	
	Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.
Pennsylvania and New York	8,256	$2,748,453	156	$53,193	134	$133,741	7	$1,304
Ohio	1,282	509,421			23	19,736		
West Virginia	107	36,756			2	1,400		
Colorado	28	8,744			1	1,800		
California	62	46,284			3	2,625		
Indiana	25	4,105			1	50		
Kentucky	4	1,142						
Illinois	1	600						
Kansas	6	2,500			2	2,500		
Missouri	1	350						
Total	9,772	3,358,355	156	53,193	166	161,852	7	1,304

Total wages paid and wages paid for the several classes of work.

States.	Total.	Wages paid in—						
		Building rigs.	Drilling wells.	Operating and caring for wells.	Torpedoing wells.	Building and repairing tankage.	Building and repairing pipe lines.	Office.
Pennsylvania and New York	$7,423,781	$478,214	$2,780,795	$3,773,139	$105,626	$110,268	$40,694	$135,045
Ohio	836,377	30,254	174,299	595,518	3,728	9,440	3,402	19,736
West Virginia	160,974	19,869	82,312	55,903	30	1,460		1,400
Colorado	34,632	2,703	8,099	21,494			536	1,800
California	75,056	3,195	20,181	49,055		50		2,625
Indiana	6,080	125	600	5,305				50
Kentucky	3,050	200	1,650	1,200				
Illinois	600			600				
Kansas	6,000	300		3,000		100	100	2,500
Missouri	350			350				
Total	8,546,900	534,860	3,067,886	4,505,564	109,384	121,318	44,732	163,156

PENNSYLVANIA.

Owing to their intimate connection in a commercial way, it is almost impossible to make an exact separation between the oil produced in New York and Pennsylvania. The basis of all information regarding the production of oil in Pennsylvania and New York is the pipe-line report, and in these reports of the Bradford district no distinction is made between the oil produced in Pennsylvania and that in New York, the Bradford district including portions of McKean county, Pennsylvania, and Cattaraugus county, New York. The returns from the northern field, as it is called, include not only the Bradford district, and, consequently, the production of the wells in Cattaraugus county, New York, but also of the wells of Allegany county, in the same State. An attempt has been made to separate the oil produced in New York from that in Pennsylvania, but at best the result must be regarded only as an approximation. In this report Pennsylvania is divided into eleven districts, as follows: (1) The Bradford district, (2) Forest county,

(3) Warren county, (4) Butler, Clarion, and Elk counties, etc., (5) Tidioute and Titusville, (6) Allegheny (Pennsylvania) county, (7) Beaver county, (8) Washington county, (9) Greene county, (10) the Franklin lubricating-oil district, and (11) Smith's Ferry district. These may be classified in a general way into the Bradford, Middle Lower and Washington or Southwestern districts.

The Bradford district lies chiefly in Pennsylvania, in McKean county, but the main field extends some 5 or 6 miles into New York. An outlying basin of oil rock, which properly belongs to the Bradford basin, is situated for the greater part in Carrollton township, Cattaraugus county, New York. This field also includes the small outlying district of Kinzua, which lies southwest from the main district and contains large and long-lived wells, and the Windfall Run field, lying in Pennsylvania, near Eldred, which has only small wells. The sand from which the oil in the Allegany (New York) and Bradford districts is obtained is a gray, black, dark brown, or chocolate brown sand of about the coarseness of the ordinary beach sand of the New Jersey coast. The oil obtained is dark amber green, and occasionally black. Its gravity is generally slightly greater than that of the oil usually obtained from the Venango and Butler districts.

The Middle field, the Warren and Forest, is located in the counties from which it takes its name. It includes such pools as Cherry Grove, Balltown and Cooper, Stoneham, Clarendon, Tiona, Kane, Grand Valley, and others in these two counties. The oil in this district comes from sands of varying geological horizons, having somewhat the general appearance of the Bradford and Allegany sand, but frequently coarser grained. The late Dr. Ashburner was of the opinion that the Allegany (New York), Bradford, Warren, and Forest district oil sands were of the Chemung (Devonian) age. The oils from the several Warren and Forest pools differ very greatly in color and gravity, but they are generally spoken of as amber oils.

The Lower field begins with a few pools in the southwestern corner of Warren county and the western end of Forest county and embraces all the oil-producing territory southward, including the fields of Venango, Clarion, and Butler counties, the field on the Ohio river in Beaver county, and the fields in Lawrence county. The oil of the Venango subdivision of the Lower district is obtained from three principal sand beds, known, respectively, as the first, second, and third oil sands, contained within an interval of about 350 feet. These sands are believed to belong to the Catskill (Devonian) formation. These sands were the first discovered in Pennsylvania, and drillers from this field operating in other districts designated the sands which were found in the new districts as the first, second, and third sands, irrespective of their geological position. The Venango sands generally consist of white, gray, or yellow pebble rock. The oils vary, though generally they are green in color, sometimes black, and in a few instances amber. The gravity varies from 30° to 51°, 48° being about the average of the oil obtained from the third sand, which is the greatest producer. The Butler subdivision of the Lower district includes oil pools in Butler, Clarion, southeastern Venango, and Armstrong counties. The character of the sands and oils are very much the same as the Venango district. The Beaver subdivision of the Lower district includes chiefly the Slippery Rock and Smith's Ferry fields. In both of these pools heavy oil is obtained from the representative of the Pottsville conglomerate and amber oil from the Berea grit, in the sub-Carboniferous series.

The Washington or Southwestern district includes the wells in Allegheny, Washington, and Greene counties, in southwestern Pennsylvania. The general character of the sands and oil is similar to that of the Lower district.

Production in Pennsylvania and New York.—In the table below is given the actual production of crude petroleum in the States of Pennsylvania and New York in 1889, by months and districts. The total production for these States was 21,487,435 barrels in 1889, and 28,458,208 barrels in 1890. These totals differ somewhat from the totals of the pipe-line runs, which are the receipts from the wells by the pipe lines as published from month to month. These runs include all the production of Pennsylvania and New York and a portion of the production of West Virginia. After making due allowance for the West Virginia runs, the totals as given in the table of production and the pipe-line totals do not differ greatly. In fact, so far as it can be ascertained, the pipe-line runs in 1889 approximated very closely to the actual production.

The production of crude petroleum in Pennsylvania and New York in 1889, by districts and months, is as follows:

Production of crude petroleum in Pennsylvania and New York in 1889, by districts and months.

[Barrels of 42 gallons.]

Districts.	Jan.	Feb.	Mar.	Apr.	May.	June.
Bradford district, Pennsylvania and New York, and Allegany county, New York	603,946	490,878	607,804	548,903	595,371	614,286
Forest county	19,537	16,737	21,689	19,393	23,699	22,647
Warren county	174,437	162,844	190,188	201,159	209,474	202,385
Butler and Clarion counties, etc	412,733	352,432	405,950	406,797	432,769	413,407
Tidioute and Titusville	66,569	61,135	70,321	67,122	83,560	72,476
Allegheny county	20,495	22,599	28,996	32,625	50,598	55,214
Beaver county	27,361	23,230	28,159	28,092	45,796	41,071
Washington county	185,516	171,165	244,474	301,799	349,192	357,033
Greene county	24,707	23,873	22,383	21,836	23,527	24,792
Franklin district	5,088	5,172	6,280	5,790	5,373	5,757
Smith's Ferry district (*a*)	2,417	2,417	2,417	2,417	2,417	2,417
Pennsylvania and New York	1,542,806	1,332,482	1,628,661	1,635,933	1,821,776	1,811,485

a. Smith's Ferry production, which was very regular, is averaged at 2,416.67 barrels per month.

Production of crude petroleum in Pennsylvania and New York, etc.—Continued.

[Barrels of 42 gallons.]

Districts.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Bradford district, Pennsylvania and New York, and Allegany county, New York	638, 763	628, 792	586, 686	618, 286	598, 952	625, 696	7, 158, 363
Forest county	23, 673	22, 336	21, 823	22, 432	23, 132	21, 857	258, 955
Warren county	211, 600	201, 766	191, 843	206, 944	195, 290	199, 504	2, 347, 434
Butler and Clarion counties, etc	451, 064	490, 873	475, 925	502, 541	484, 772	529, 140	5, 358, 403
Tidioute and Titusville	77, 392	75, 450	68, 728	78, 365	80, 920	83, 081	885, 119
Allegheny county	56, 529	54, 387	49, 942	59, 086	49, 606	61, 015	541, 092
Beaver county	51, 675	49, 354	49, 545	57, 670	78, 007	122, 776	602, 736
Washington county	401, 325	397, 093	376, 007	363, 830	351, 509	349, 202	3, 848, 145
Greene county	33, 819	36, 767	38, 768	42, 719	44, 176	55, 545	392, 912
Franklin district	5, 911	4, 992	5, 927	4, 880	5, 091	5, 015	65, 276
Smith's Ferry district (*a*)	2, 417	2, 417	2, 416	2, 416	2, 416	2, 416	29, 000
Pennsylvania and New York	1, 954, 168	1, 964, 227	1, 867, 610	1, 959, 169	1, 913, 871	2, 055, 247	21, 487, 435

a Smith's Ferry production, which was very regular, is averaged at 2,416.67 barrels per month.

The total production of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1889, by months and years, is as follows:

Total product of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1890, by months and years.

[Barrels.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340	456, 475	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130	517, 762	549, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	632, 617	608, 300	665, 291	641, 520	776, 364	793, 470	867, 473	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 893, 786
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	921, 750	1, 033, 447	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	852, 159	719, 824	789, 539	675, 060	696, 508	696, 210	788, 361	718, 766	698, 940	731, 073	700, 200	720, 874	8, 787, 514
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600	763, 623	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	842, 890	783, 216	901, 697	972, 810	1, 127, 594	1, 180, 790	1, 189, 005	1, 273, 759	1, 214, 910	1, 269, 326	1, 173, 420	1, 256, 058	13, 135, 475
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250	1, 283, 865	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650	1, 637, 767	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 685, 176
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440	2, 248, 430	2, 341, 027	2, 346, 300	2, 385, 636	2, 274, 420	2, 238, 634	26, 027, 631
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860	2, 372, 678	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940	3, 258, 162	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 053, 500
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900	2, 020, 394	1, 879, 437	1, 913, 370	2, 076, 659	1, 958, 340	1, 988, 526	23, 128, 389
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190	2, 059, 950	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210	1, 775, 804	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041
1886	1, 748, 958	1, 604, 848	1, 928, 448	1, 938, 360	2, 178, 773	2, 335, 380	2, 418, 961	2, 413, 206	2, 418, 540	2, 408, 111	2, 222, 790	2, 181, 625	25, 798, 000
1887	1, 990, 851	1, 827, 924	2, 007, 196	1, 960, 860	1, 993, 517	1, 912, 860	1, 899, 525	1, 848, 877	1, 779, 930	1, 843, 291	1, 125, 450	1, 288, 602	*a*21, 478, 883
1888	1, 155, 937	1, 290, 718	1, 338, 877	1, 349, 403	1, 473, 362	1, 450, 703	1, 394, 847	1, 382, 077	1, 273, 080	1, 354, 518	1, 442, 405	1, 582, 741	16, 488, 668
1889	1, 542, 806	1, 332, 482	1, 628, 661	1, 635, 933	1, 821, 776	1, 811, 485	1, 954, 168	1, 964, 227	1, 867, 610	1, 959, 169	1, 913, 871	2, 055, 247	21, 487, 435
1890	2, 108, 248	2, 055, 424	2, 313, 189	2, 328, 870	2, 378, 382	2, 370, 001	2, 524, 206	2, 514, 968	2, 584, 949	2, 750, 698	2, 575, 941	2, 626, 035	*b*29, 130, 910

a Not including 877,310 barrels dump oil and oil shipped by private lines.
b Pipe line runs.

For some years previous to and including 1887 the total production as given is simply the total of the pipe-line runs. The statistics in the early years, as indeed all of the figures up to the close of 1888, are those published in Stowell's Petroleum Reporter. As the pipe-line runs for 1888 and 1889 differ from the totals of production as given in the above table, and as these runs are of sufficient importance to those interested in the production of petroleum to become a matter of record, the runs of these two years are given below.

The runs of the several pipe lines for 1889, as reported from month to month in Pennsylvania and New York and that portion of West Virginia tributary to the southwestern Pennsylvania field, are as follows, by months and lines:

Pipe-line runs in Pennsylvania and New York in 1889, by lines and months.

[Barrels.]

Months.	National.	Tide water.	Octave.	Miller.	Western Atlantic.	Southwest.	Franklin.	Total.
January	1,071,087	128,904	1,847	16,734	110,718	178,720	5,002	1,513,012
February	901,549	104,962	2,034	14,564	105,060	174,397	5,080	1,307,652
March	1,102,168	111,387	2,179	17,020	142,150	227,657	6,194	1,608,755
April	1,071,665	89,900	2,079	17,277	176,699	265,879	5,704	1,629,203
May	1,119,920	126,692	2,908	16,497	207,896	314,929	5,287	1,794,129
June	1,104,626	133,160	2,421	15,877	209,506	333,410	5,671	1,804,671
July	1,181,200	132,106	2,719	17,348	232,940	373,530	5,825	1,945,668
August	1,174,489	130,835	3,186	15,399	277,143	355,468	4,906	1,961,426
September	1,103,009	125,908	3,863	14,818	277,662	329,044	5,841	1,860,140
October	1,185,362	133,965	3,818	14,362	263,834	362,878	4,794	1,968,513
November	1,118,210	146,226	2,668	14,086	243,813	368,618	5,005	1,898,626
December	1,542,491	229,894	8,814	14,136	254,405	449,989	4,929	2,499,158
Total	13,675,776	1,593,939	32,536	188,113	2,501,826	3,734,519	64,244	21,790,953

The total runs by months for 1888 and 1889 are given below. It should be borne in mind, as stated above, that the runs for 1889 include a portion of the production of West Virginia as well as all of the production of Pennsylvania and New York.

Pipe-line runs in Pennsylvania and New York in 1888 and 1889, by months.

[Barrels.]

Months.	1888.	1889.	Months.	1888.	1889.
January	1,126,035	1,513,012	August	1,365,992	1,961,426
February	1,240,092	1,307,652	September	1,253,149	1,860,140
March	1,211,086	1,608,755	October	1,311,643	1,968,513
April	1,320,936	1,629,203	November	1,416,448	1,898,626
May	1,433,469	1,794,129	December	1,550,902	2,499,158
June	1,422,960	1,804,671			
July	1,370,080	1,945,668	Total	16,022,792	21,790,953

Monthly and yearly average price of pipe-line certificates or crude petroleum at the well for the years 1882 to 1890.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
January	$0.83⅛	$0.93¾	$1.11	$0.70⅞	$0.8[illegible]⅜	$0.70	$0.91¼	$0.86⅝	$1.06⅜
February	.84⅛	1.01	1.04⅝	.72⅛	.79⅞	.64⅝	.91⅝	.89¼	1.05⅛
March	.81⅜	.97⅝	.98⅛	.80⅛	.77½	.63⅝	.93⅝	.90⅞	.90
April	.78⅜	.92⅜	.94	.78⅛	.74⅛	.64⅞	.82⅝	.88	.82⅝
May	.71⅛	1.00⅛	.85⅝	.79	.70	.64⅛	.86⅞	.83⅛	.88⅞
June	.54⅜	1.16⅜	.68⅝	.82	.66⅛	.62⅝	.75⅞	.83⅞	.89½
July	.57⅒	1.05⅞	.63⅛	.92⅛	.66	.59½	.80⅝	.95⅛	.89⅛
August	.58⅝	1.08⅛	.81⅛	1.00⅛	.62⅛	.60⅛	.90⅛	.99⅛	.89½
September	.72⅛	1.12⅜	.78	1.00⅜	.63⅜	.67	.93⅝	.99⅝	.81⅞
October	.93¾	1.11⅛	.71⅛	1.05⅛	.65⅛	.70⅞	.90⅝	1.01⅜	.80⅛
November	1.14	1.14⅛	.72⅛	1.04⅛	.71⅝	.73⅞	.85⅜	1.08⅛	.72⅜
December	.96	1.14⅜	.74⅝	.89⅞	.70⅝	.80½	.89½	1.04⅛	.67½
Average	.78⅞	1.05¾	.83⅛	.88	.71½	.66¾	.87⅝	.94⅛	.80¾

Quantity of crude petroleum produced in, and the quantity and value of petroleum products exported from, the United States during the fiscal years 1864 to 1884, and calendar years 1885 to 1890.

Years ended—	Production (a).		Exports.											
	Barrels (of 42 gallons) produced.	Gallons produced.	Mineral, crude (including all natural oils without regard to gravity).		Mineral, refined or manufactured.						Residuum (tar, pitch, and all other from which the light bodies have been distilled).		Total.	
					Naphthas, benzine, gasoline, etc.		Illuminating.		Lubricating (heavy paraffin, etc.).					
			Gallons.	*Value.*	*Gallons.*	*Value.*	*Gallons.*	*Value.*	*Gallons.*	*Value.*	*Gallons (b).*	*Value.*	*Gallons.*	*Value.*
June 30, 1864..	2,478,709	104,105,778	9,980,654	$3,864,187	438,197	$154,091	12,791,518	$6,764,411	....	....	....	....	23,210,368	$10,782,689
1865..	2,424,905	101,846,010	12,293,897	6,868,513	480,947	173,943	12,722,005	9,520,957	....	....	....	....	25,496,849	16,563,413
1866..	3,165,700	132,959,400	16,057,943	6,015,921	673,477	188,825	34,255,921	18,626,141	....	....	....	....	50,987,341	24,830,887
1867..	3,591,900	150,859,800	7,344,248	1,864,001	224,576	34,175	62,686,657	22,509,466	....	....	....	....	70,255,481	24,407,642
1868..	3,613,709	151,775,778	10,029,659	1,564,933	1,517,268	267,873	67,909,961	19,977,870	....	....	....	....	79,456,888	21,810,676
1869..	4,046,558	169,955,436	13,425,566	2,994,404	2,673,094	445,770	84,403,492	27,636,187	c 134,532	$51,122	....	....	100,636,684	31,127,433
1870..	4,411,016	185,262,672	10,403,314	2,237,292	5,422,604	564,864	97,902,505	29,864,193	c 6,871	2,611	....	....	113,735,294	32,668,960
1871..	5,558,775	233,468,550	9,859,038	1,971,847	7,209,592	746,797	132,608,955	34,138,736	c 59,632	22,660	c 155,474	$14,770	149,892,691	36,894,810
1872..	5,842,497	245,384,874	13,559,768	2,307,111	8,092,685	932,160	122,539,575	30,566,108	541,419	211,287	438,186	41,724	145,171,583	34,058,390
1873..	7,242,343	304,178,406	18,439,407	3,010,050	9,743,593	1,487,439	158,102,414	37,195,735	748,699	277,966	781,074	79,506	187,815,187	42,050,756
1874..	11,188,741	469,927,122	17,776,419	2,099,696	9,737,457	1,038,622	217,220,504	37,560,995	1,244,305	404,243	1,827,798	142,299	247,806,483	41,245,815
1875..	10,083,828	423,520,776	14,718,114	1,406,018	11,758,940	1,141,440	191,551,933	27,030,361	1,173,473	313,646	2,752,848	187,103	221,955,308	30,078,568
1876..	8,823,142	370,571,964	20,520,397	2,220,268	14,780,236	1,442,811	204,814,673	28,755,638	963,442	303,863	2,581,404	193,206	243,660,152	32,915,786
1877..	10,822,871	454,560,582	26,819,202	3,756,729	15,140,183	1,816,682	262,441,844	55,401,132	1,601,065	497,540	3,196,620	317,355	309,198,914	61,789,438
1878..	14,738,262	619,007,004	26,936,727	2,694,018	16,416,621	1,411,812	289,214,541	41,513,676	2,304,624	639,381	3,968,790	316,087	338,841,303	46,574,974
1879..	16,917,606	710,539.452	25,874,488	2,180,413	15,054,361	1,258,780	331,586,442	35,999,862	2,487,681	655,468	3,307,038	210,726	378,310,010	40,305,249
1880..	22,382,509	940,065,378	28,297,997	1,927,207	18,411,044	1,192,229	367,325,823	31,783,575	5,162,835	1,039,124	4,767,000	276,490	423,964,699	36,218,625
1881..	25,805,363	1,083,825,246	39,984,844	3,065,464	17,292,310	1,693,975	332,283,045	34,317,695	4,852,203	1,054,064	3,247,860	184,411	397,660,262	40,315,609
1882..	28,650,181	1,203,307,602	41,304,997	3,129,511	20,213,098	1,809,143	488,213,033	44,588,854	6,508,100	1,492,396	3,715,362	212,802	559,954,590	51,232,706
1883..	26,662,808	1,119,837,936	52,712,306	3,914,941	17,070,537	1,302,286	419,821,081	36,926,574	10,182,342	2,326,632	6,145,356	442,646	505.931,622	44,913,079
1884..	23,744,924	997,286,808	67,186,329	5,302,974	15,045,411	1,072,651	415,615,693	38,195,349	10,515,535	2,179,595	5,297,124	352,679	513,660,092	47,103,248
Dec. 31, 1885..	20,776,041	872,593,722	81,435,609	6,040,685	14,739,469	1,160,999	445,531,886	39,439,034	13,327,584	2,690,258	7,319,130	311,656	562,353,178	49,642,632
1886..	25,798,000	1,083,516,000	76,342,480	5,068,409	14,474,951	1,264,736	485,120,680	39,012,922	13,948,367	2,689,464	1,993,824	119,673	591,880,302	48,155,204
1887..	21,478,883	902,113,086	80,650,286	5,141,833	12,382,203	1,049,043	485,242,107	37,007,336	20,582,613	3,559,280	2,989,098	141,350	601,846,307	46,898,842
1888..	16,491,084	692,625,528	77,609,452	5,461,305	13,481,706	1,083,429	454,985,784	37,229,551	24,510,437	4,215,449	1,870,596	116,009	572,457,975	48,105,743
1889..	21,487,435	902,472,270	85,189,658	6,134,002	13,984,407	1,208,116	551,769,666	41,215,192	27,903,267	4,638,724	1,858,458	97,265	680,705,456	53,293,299
1890..	28,458,208	1,195,244,736	95,450,653	6,744,235	12,937,433	1,134,799	523,295,090	38,640,638	30,162,522	4,763,347	2,222,472	120,070	664,068,170	51,403,089

a As a given number of gallons of refined petroleum represents the product of a larger number of gallons of crude petroleum, it is necessary to reduce the exports of petroleum to their equivalent in crude oil, in order to arrive at a knowledge of the percentage of the total product of mineral oil exported. It has been ascertained, as the result of careful computation, that the quantity of petroleum and its distilled products exported during the year ended June 30, 1878, was equivalent to 407,482,175 gallons of crude oil; or, in other words, that the exports of petroleum constituted about 66 per cent. of the production. A larger percentage of the mineral oil product of the country is exported than of any other product, except cotton.

b Barrels reduced to gallons, at the rate of 42 gallons to the barrel.

c Estimated.

The values of the illuminating oils in Pennsylvania are based on the average value of pipe-line certificates. These averages for 1889, by months, were as follows:

Monthly average price of pipe-line certificates in 1889.

January	$0.86⅝	July	$0.95⅛
February	0.89⅛	August	0.99⅛
March	0.90⅞	September	0.99⅛
April	0.88	October	1.01⅜
May	0.83⅛	November	1.08⅛
June	0.83⅞	December	1.04⅛
Average			$0.94⅛

These averages it is to be understood are not true averages, that is, the average which considers both price and quantity sold at that price, but they are the averages of the prices obtained in the different primary markets from day to day, which are the bases of the prices paid by the larger consumer, the Standard Oil Company, for all oil bought by them on that day. It is probable that the true average prices are slightly under the averages usually obtained. These, however, under the circumstances, are the only averages that can be ascertained, and do not vary greatly from the average of the prices.

The only oil that sold at the average in 1889 was that from the Bradford-Allegany district. The oil from each of the other districts commanded a premium above the price of pipe-line certificates, owing to its being better adapted to the production of light products and water-white oil. The average premium, as it was called, in the Forest, Warren, Butler, Clarion-Venango, and Allegheny (Pennsylvania) districts was 20 cents; in the other districts, 25 cents.

The total production, total value, and average value of all of the oil produced in the Pennsylvania and New York district in 1889, by districts, were as follows:

Total production, total value, and average value of crude petroleum produced in the Pennsylvania and New York districts in 1889, by districts.

Districts.	Illuminating.			Lubricating.		
	Production.	Value.	Price per barrel.	Production.	Value.	Price per barrel.
	Barrels.			*Barrels.*		
Bradford-Allegany	7,158,363	$6,737,809	$0.94⅛			
Forest	258,955	295,532	1.14⅛			
Warren	2,347,434	2,679,010	1.14⅛			
Butler-Clarion-Venango(*a*)	6,243,522	7,125,421	1.14⅛			
Allegheny, Pennsylvania	541,092	617,512	1.14⅛			
Beaver	602,736	718,010	1.19⅛	*b*29,000	$34,546	$1.19⅛
Washington	3,848,145	4,584,103	1.19⅛			
Greene	392,912	468,056	1.19⅛			
Franklin				65,276	215,164	3.30
Total	21,393,159	23,225,453	1.08⅝	94,276	249,710	2.64⅞

a Including Tidioute and Titusville district.

b Smith's Ferry district.

In the table from Stowell's Petroleum Reporter, given on the following page, will be found the monthly and yearly average of pipe-line certificates or the prices at primary markets of crude petroleum per barrel of 42 gallons from 1865 to 1890, inclusive. The remarks made above regarding the value of these averages should be noted in examining this table; that is, that these are not true average prices, but the average of the prices obtained daily.

Monthly and yearly average prices of pipe-line certificates of crude petroleum at wells from 1865 to 1890.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly.
1865	$8.25	$7.50	$6.00	$6.00	$7.37½	$5.62½	$5.12½	$4.62½	$6.75	$8.12½	$7.25	$6.50	$6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	3.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82½	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	6.70	5.35	4.95	5.87½	5.57½	5.50	5.50	5.80	5.12½	5.63¼
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22	3.40	3.84
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.80	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.63
1873	2.60	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.87
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	0.95	0.95	0.85	0.55	0.61½	1.15
1875	1.03	1.52½	1.75	1.36½	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.36
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.87½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅝	2.07½	2.51	2.38	2.56¼	1.91	1.80	2.42
1878	1.43	1.65¼	1.59	1.37½	1.35¼	1.14	0.98½	1.01	0.86⅝	0.82½	0.89⅜	1.16	1.19
1879	1.03	0.98	0.86¼	0.78½	0.76	0.68⅜	0.69⅞	0.67½	0.69⅜	0.88½	1.05⅜	1.18½	0.85⅞
1880	1.10¼	1.03½	0.88¾	0.78	0.80	1.00	1.06¼	0.91	0.96	0.96⅞	0.91⅞	0.91⅝	0.94⅛
1881	0.95½	0.90⅜	0.83⅜	0.86¼	0.81⅞	0.81¼	0.76⅞	0.78½	0.97½	0.91¼	0.85¼	0.84⅜	0.85⅞
1882	0.83⅜	0.84⅛	0.81⅞	0.78⅜	0.71⅛	0.54⅜	0.57⅜	0.58⅝	0.72⅛	0.93¾	1.14	0.96	0.78⅛
1883	0.93¾	1.01	0.97⅝	0.94⅜	1.00⅝	1.16⅜	1.05⅞	1.08	1.12¼	1.11½	1.14½	1.14⅝	1.05¾
1884	1.11	1.04⅜	0.98½	0.94	0.85⅝	0.68⅝	0.63⅛	0.81⅞	0.78	0.71½	0.72½	0.74⅜	0.83⅛
1885	0.70⅞	0.72⅜	0.80⅜	0.78½	0.79	0.82	0.92½	1.00¼	1.00¾	1.05¼	1.04⅜	0.89⅝	0.87⅞
1886	0.88⅜	0.79⅞	0.77¼	0.74½	0.70	0.66½	0.66	0.62¼	0.63¼	0.65½	0.71⅝	0.70⅝	0.71¼
1887	0.70	0.64⅝	0.63⅜	0.64⅞	0.64½	0.62⅝	0.59½	0.60½	0.67	0.70⅞	0.73⅞	0.80¾	0.66¾
1888	0.91¼	0.91⅝	0.93⅜	0.82⅜	0.86¼	0.75⅞	0.80⅝	0.90½	0.93⅝	0.90⅝	0.85⅜	0.89¼	0.87⅝
1889	0.86⅝	0.89¼	0.90⅞	0.88	0.83½	0.83⅞	0.95½	0.99½	0.99½	1.01⅜	1.08½	1.04½	0.94½
1890	1.05¼	1.03½	0.90	0.82⅛	0.88⅞	0.89¼	0.89½	0.89¼	0.81⅞	0.80½	0.72⅜	0.67¼	0.86¾

Shipments of petroleum from Pennsylvania and New York.—In the following table will be found a statement of the number of barrels of crude petroleum and of refined petroleum reduced to its equivalent shipped out of the Pennsylvania and New York oil regions either by pipe line or railroad from 1871 to 1890, inclusive. In some years, especially in the earlier ones covered by this table, a considerable portion of the oil was shipped as refined. In this table that is reduced to its equivalent in crude, a barrel of refined being regarded as being produced from 1⅓ barrels of crude.

Shipments of crude petroleum and refined petroleum, reduced to crude equivalent, out of the Pennsylvania and New York oil fields for the years 1871–'90, by months and years.

[Barrels.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1871	437,691	347,718	383,890	389,147	587,375	501,754	541,137
1872	476,966	407,606	276,220	428,512	510,417	529,228	591,238
1873	573,124	527,440	668,374	708,191	768,176	696,414	814,449
1874	843,663	501,220	518,246	803,409	899,027	815,413	940,281
1875	453,095	327,776	693,918	729,581	681,679	745,986	904,537
1876	677,289	519,193	623,762	603,037	646,150	921,862	1,228,539
1877	743,461	484,904	913,919	903,526	1,234,324	1,391,124	1,096,951
1878	775,791	774,234	741,512	846,632	960,894	1,135,119	1,330,454
1879	663,998	702,729	973,879	1,136,188	1,331,469	1,369,314	1,625,035
1880	1,650,409	1,395,151	1,613,371	842,268	1,095,259	975,083	1,231,611
1881	1,061,617	915,028	1,276,746	1,848,398	1,563,436	1,729,697	1,925,532
1882	1,657,067	1,787,909	1,718,956	1,678,134	1,827,356	2,172,685	2,402,970
1883	1,357,815	1,250,824	1,641,899	1,908,379	1,995,634	1,747,789	1,634,407
1884	1,686,961	1,723,261	1,873,890	1,643,336	1,899,329	1,827,553	1,740,021
1885	1,804,028	1,895,021	1,887,034	1,823,726	2,097,099	2,034,025	1,961,152
1886	1,991,561	2,032,794	2,055,750	2,070,468	2,082,672	2,117,489	2,418,961
1887	2,312,067	1,995,757	2,332,324	1,938,278	2,328,564	2,165,439	2,000,173
1888	2,265,109	2,163,957	1,979,753	1,928,435	1,773,994	1,956,115	2,098,531
1889	2,388,609	2,272,060	2,263,009	2,236,004	2,256,120	2,268,280	2,949,597
1890	2,637,339	2,146,108	2,148,977	2,817,410	2,474,966	2,486,205	2,640,668

Shipments of crude petroleum and refined petroleum, etc.—Continued.

[Barrels.]

Year.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1871	528, 134	551, 075	505, 071	480, 977	410, 822	5, 664, 791
1872	621, 954	541, 607	607, 468	477, 945	430, 786	5, 899, 947
1873	864, 768	952, 955	1, 010, 852	959, 589	955, 443	9, 499, 775
1874	793, 865	1, 014, 570	543, 341	546, 117	602, 348	8, 821, 500
1875	882, 089	1, 109, 392	871, 917	671, 066	871, 902	8, 942, 938
1876	1, 203, 402	1, 154, 549	524, 190	871, 496	1, 190, 983	10, 164, 452
1877	1, 425, 943	1, 563, 797	1, 268, 971	1, 205, 634	600, 019	12, 832, 573
1878	1, 655, 651	1, 434, 225	1, 747, 390	1, 281, 410	992, 688	13, 676, 000
1879	1, 808, 239	1, 627, 120	1, 662, 269	1, 453, 645	1, 532, 585	15, 886, 470
1880	1, 394, 129	1, 252, 635	1, 665, 933	1, 226, 030	1, 335, 613	15, 677, 492
1881	2, 214, 877	2, 131, 950	2, 080, 467	2, 066, 906	1, 969, 581	20, 284, 235
1882	2, 047, 545	1, 992, 171	2, 089, 428	1, 404, 640	1, 121, 453	21, 900, 314
1883	2, 086, 478	2, 325, 574	2, 215, 421	2, 065, 602	1, 749, 547	21, 979, 369
1884	2, 000, 371	2, 292, 087	2, 510, 283	2, 078, 261	2, 382, 244	23, 657, 597
1885	2, 049, 099	2, 116, 659	2, 050, 150	1, 857, 080	2, 138, 253	23, 713, 326
1886	2, 059, 299	2, 157, 323	2, 441, 848	2, 724, 796	2, 550, 891	26, 653, 852
1887	2, 220, 768	2, 342, 227	2, 573, 008	2, 462, 082	2, 608, 341	27, 279, 028
1888	2, 223, 263	2, 289, 486	1, 558, 115	2, 503, 491	2, 397, 782	25, 138, 031
1889	2, 625, 825	2, 567, 459	2, 747, 284	2, 393, 131	2, 671, 518	29, 638, 898
1890	2, 538, 224	2, 648, 418	2, 725, 341	2, 662, 898	2, 889, 525	30, 116, 075

These shipments are, for the latter years, chiefly what are known as pipe-line deliveries. It will be seen that the shipments for 1889 were the largest in the history of the trade, being 2,359,870 barrels greater than in 1887, the year of the largest previous shipment, when the total shipments were 27,279,028 barrels. It will also be noted that the shipments were over 8,000,000 barrels in excess of the production. This increased shipment makes itself very manifest in the statement of stocks held in the Pennsylvania and New York oil regions at the close of 1889, which are given below.

These figures of shipments must not be taken as showing the actual consumption of oil. To them must be added, in order to ascertain what becomes of the oil produced in the oil regions, all of the sediment, the dump oil, or oil that does not pass through the pipe line, as well as the amount of oil destroyed by fire and disposed of in other ways than by refining or direct consumption. There is also a certain amount of loss by evaporation and otherwise. This is provided for by the pipe lines in receiving the oil from the producers, a certain number of gallons per barrel being allowed for such loss. Forty-four gallons are generally delivered by the producer to the pipe line as a barrel, but certificates are issued for barrels of 42 gallons only.

Stocks of crude petroleum in the Pennsylvania and New York oil fields.—The reduction in stocks of petroleum held by the pipe lines in 1889 was most notable. The stocks at the close of that year, as will be seen in the following table, were less than at any time since 1879, being on December 31, 1889, 11,562,593 barrels, compared with 8,470,490 barrels at the close of 1879. Between 1879 and 1889 the stocks had risen to 37,366,126 barrels at the close of December, 1884. From this there was a gradual reduction until 1887, when the stocks stood 28,006,211 barrels on December 31 of that year, from which they dropped a little more than 9,000,000 barrels, or to 18,995,814, at the close of 1888, and to

11,562,593 at the close of 1889, notwithstanding, as has already been pointed out, the greatly increased production in 1889 over 1888. This increase, as above stated, in the Pennsylvania and New York oil fields was 4,998,767 barrels, yet the decrease in stocks was 7,433,221 barrels.

The following table shows the total stocks of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1890, by months and years:

Total stocks of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'90, by months and years.

[Barrels.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1871	537,751	587,021	642,000	771,000	605,000	554,000	511,220
1872	532,971	579,793	662,497	877,832	950,803	1,010,302	990,229
1873	1,183,728	1,265,373	1,244,657	1,178,643	1,192,541	1,324,493	1,433,620
1874	1,948,919	2,283,032	2,648,210	2,623,534	2,594,286	2,701,625	2,279,479
1875	4,011,703	4,546,188	4,592,364	4,537,843	4,552,672	4,502,896	4,386,720
1876	3,585,143	3,734,835	3,829,250	3,900,703	3,989,904	3,791,642	3,326,726
1877	2,604,128	2,860,636	3,210,454	3,279,731	3,173,008	2,912,674	3,004,728
1878	3,555,342	3,875,964	4,342,832	4,692,090	4,996,058	5,078,189	5,031,600
1879	5,321,222	5,813,663	6,318,099	6,689,111	6,980,064	7,263,150	7,353,382
1880	8,724,194	9,004,062	9,606,683	10,780,153	11,916,577	13,099,984	14,116,753
1881	20,110,903	21,108,003	22,105,789	22.963,171	23,793,028	24,441,191	24,888,337
1882	26,716,188	27,059,611	27,822,825	28,547,481	29,206,697	29,859,952	30,715,144
1883	35,187,116	35,692,480	35,881,255	37,789,406	35,755,824	35,965,935	36,371,922
1884	35,884,509	36,041,898	36,220,270	36,642,794	38,631,203	38,665,838	38,985,767
1885	37,214,274	36,757,137	36,508,236	36,464,800	36,139,072	35,872,257	35,686,909
1886	34,186,238	34,082,775	33,954,493	33,823,385	33,969,486	34,187,377	34,428,490
1887	33,835,389	33,288,630	32,932,502	32,955,084	32,642,330	32,389,750	32,289,269
1888	26,927,634	26,084,574	25,404,276	24,893,223	24,653,043	24,219,496	23,586,951
1889	18,165,607	17,240,428	16,634,437	16,076,501	15,668,331	15,258,863	14,541,696
1890	11,060,220	10,990,417	11,170,997	11,178,990	11,062,100	10,866,587	10,663,497

Years.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
1871	530,146	541,330	495,102	502,960	532,000	567,458
1872	997,166	951,410	914,423	886,909	1,084,423	869,897
1873	1,513,890	1,521,185	1,452,777	1,493,875	1,625,157	1,369,162
1874	2,932,444	2,758,504	3,134,902	3,449,845	3,705,639	2,755,035
1875	4,223,397	3,812,945	3,672,101	3,701,235	3,550,207	4,174,189
1876	3,304,405	2,930,456	3,040,108	2,955,092	2,551,199	3,411,622
1877	2,852,544	2,503,657	2,504,012	2,471,798	3,127,837	2,875,434
1878	4,717,877	4,599,362	4,221,769	4,289,309	4,615,299	4,501,308
1879	7,114,195	7,620,525	7,794,634	8,051,469	8,470,490	7,065,834
1880	15,063,651	16,157,316	16,877,019	18,025,409	18,928,430	13,525,015
1881	25,005,187	25,066,657	25,309,361	25,509,285	26,019,704	23,860,051
1882	31,772,094	32,400,303	32,608,533	33,728,555	34,596,612	30,419,500
1883	36,164,881	35,752,677	35,613,915	35,506,653	35,745,632	35,953,975
1884	39,064,561	38,740,734	38,192,317	37,925,756	37,366,126	37,698,481
1885	35,343,771	34,939,902	34,763,857	34,668,437	34,428,841	35,732,291
1886	34,800,397	35,061,614	35,027,877	34,525,871	34,156,605	34,350,384
1887	32,003,536	31,840,939	30,662,583	29,325,951	28,006,211	31,806,015
1888	22,825,298	21,876,681	20,722,024	19,734,132	18,995,814	23,326,929
1889	13,859,267	13,198,452	12,468,969	12,021,924	11,562,593	14,724,756
1890	10,526,613	10,346,878	10,263,258	10,080,538	9,993,600	10,682,807

For the last two years the total stocks of petroleum as given in the foregoing table are in excess of those held by the pipe lines. The stocks given in the table include, in addition to those held by the pipe lines, all that are held at wells, but not those of crude held at refineries.

Well records in the Pennsylvania and New York oil fields.—In the tables following are given what are known as the well records; that is, the statistics of the drilling of new wells and the number of producing wells in Pennsylvania and New York. New York is included in this well report for reasons previously given, namely, that in the pipe line reports it is so difficult to arrive at the exact statistics of production in the oil territory in New York contiguous to Pennsylvania, the oil pools running from one State into the other and the oil being run through pipe lines to a common receptacle, often without any opportunity of measuring the oil from different wells in the different States belonging to the same parties.

In the following table is shown the number of rigs building, preparatory to drilling wells, at the close of each month of 1889, by districts and by totals:

Number of rigs building in the Pennsylvania and New York oil fields at the close of each month during 1889, by districts.

Months.	Bradford-Allegany.	Forest.	Warren	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.	Total.
January	26	8	18	108	37	19	1	7	219
February	27	12	1	132	34	18	....	5	229
March	55	2	23	153	43	18	....	7	311
April	52	1	16	134	33	17	7	7	267
May	45	2	14	122	50	34	....	12	279
June	55	1	13	126	36	33	7	7	278
July	53	6	13	107	34	29	....	4	246
August	81	6	34	144	46	22	....	18	351
September	58	3	34	179	18	27	13	15	347
October	102	9	46	191	42	12	15	10	427
November	120	11	27	199	64	6	14	12	453
December	96	2	27	213	60	5	5	14	422
Total	770	58	276	1,808	497	240	62	118	3,829

From this it will be seen that the number of rigs building increased from January to March, was stationary to the close of June, declined a little in July, increased rapidly from August to November, when the number was 453, the largest number during the year.

In the following table is given the number of wells actually drilling at the close of each month in 1889, by districts. This includes only drilling wells, excluding rigs building and wells actually completed during or at the close of the month.

Number of wells drilling at the close of each month in 1889, by districts.

Months.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.	Total.
January	45	3	19	174	56	22	2	20	341
February	50	17	5	151	92	13	....	22	350
March	63	3	44	186	113	25	....	19	453
April	79	3	16	179	143	41	7	19	487
May	93	2	43	206	132	79	....	19	574
June	76	5	34	205	170	105	1	16	612
July	97	4	36	193	148	113	5	2	598
August	113	6	49	194	148	61	....	27	598
September	85	9	43	230	142	59	10	22	600
October	166	14	85	273	150	28	13	19	696
November	139	9	37	275	124	35	12	28	659
December	148	10	45	231	132	19	4	21	610
Total	1,154	85	406	2,497	1,550	600	54	234	6,580

About the same remarks may be made on this table as were made in regard to that showing the number of rigs building, except that the increase was a gradual one from the beginning of the year to the last of June, and was then stationary until the last of September, 1889, increasing over 16 per cent. in October, making the total number of wells drilling at the close of October 698, the largest number of wells drilling at the close of any one month during the period covered by the table given below, or from 1871 to 1890.

Number of drilling wells in the Pennsylvania and New York oil fields at the close of each month for the years 1871–1890, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
1871	140	173	240	279	856	803	829	330	439	486	477	394	329
1872	363	369	313	302	386	391	359	392	301	311	354	318	347
1873	361	349	227	177	228	395	840	267	197	163	137	60	242
1874	37	55	99	213	225	210	180	128	107	82	57	54	121
1875	40	40	45	64	127	162	118	96	132	170	179	168	112
1876	142	151	230	267	307	840	353	874	511	565	618	493	363
1877	457	463	895	448	512	395	365	417	535	573	565	426	463
1878	334	326	379	409	376	266	188	185	240	282	297	218	292
1879	265	323	406	468	460	884	329	258	270	313	372	440	357
1880	540	535	577	580	460	440	452	515	491	469	475	408	495
1881	383	420	437	446	470	408	879	352	888	445	475	468	423
1882	422	438	408	405	381	226	240	194	177	184	154	138	281
1883	126	151	205	199	216	228	262	315	314	341	301	263	243
1884	270	273	260	284	244	123	123	91	79	100	86	78	168
1885	97	109	139	190	228	209	242	808	382	855	359	277	241
1886	320	337	356	318	358	403	349	290	322	272	285	238	321
1887	201	177	155	155	157	142	135	137	107	104	114	88	139
1888	64	72	65	59	82	106	124	106	166	187	827	273	136
1889	341	350	453	487	574	612	598	598	600	698	659	610	548
1890	597	608	645	603	585	617	643	683	632	644	542	445	604

The effect of the increased demand for petroleum and the decrease in stocks, shown in previous tables, and the reduction of production, owing to the shut-down in 1888, will be seen by comparing the figures of wells drilling in 1888 and 1889, as shown in the above table. It will be remembered that the shut-in began in November, 1887, and lasted until November, 1888. In January, 1888, there were but 64 wells drilling, as compared with 341 in the same month of 1889. The average for 1888 was 136 wells, as compared with 548 for 1889.

In the following table is given a statement of the number of wells completed in each district in the Pennsylvania and New York oil fields during each month of 1889, by months and districts:

Number of wells completed in the Pennsylvania and New York oil fields in 1889, by months and districts.

Months.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.	Total.
January	39	4	32	180	16	7	....	6	284
February	34	1	16	207	10	14	....	6	288
March	52	2	38	196	49	8	....	8	353
April	59	1	52	224	51	6	3	5	401
May	82	4	46	207	47	34	....	11	431
June	83	4	71	275	54	34	4	12	537
July	107	9	62	228	60	69	....	14	549
August	104	7	65	233	71	23	....	5	508
September	97	2	70	222	50	5	26	6	478
October	143	7	62	250	69	18	8	12	559
November	121	9	72	252	56	5	15	10	540
December	113	5	50	211	54	8	27	3	471
Total	1,034	55	636	2,685	577	231	83	98	(a)5,435

[a] Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

The following table gives the number of drilling wells completed in each month from January, 1872, to the close of 1890.

Number of drilling wells completed in the Pennsylvania and New York oil fields each month for the years 1872–1890, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1872	37	120	89	121	135	84	128	118	82	100	64	105	1,183
1873	93	94	100	105	102	130	114	120	106	101	100	98	1,263
1874	102	104	110	113	109	101	121	107	104	120	106	120	1,317
1875	190	187	195	186	172	190	200	210	201	220	217	230	2,398
1876	240	231	242	200	202	261	248	270	209	273	272	272	2,920
1877	281	241	291	269	320	403	317	255	322	467	391	382	3,939
1878	274	226	211	409	470	269	203	186	174	229	248	165	3,064
1879	136	182	238	270	402	330	327	283	210	232	227	261	3,048
1880	320	230	367	500	426	310	338	368	356	364	336	302	4,217
1881	222	220	271	316	406	374	336	332	312	322	363	406	3,880
1882	347	340	385	432	469	340	185	253	164	117	150	122	3,304
1883	125	126	142	209	231	228	261	309	321	321	302	272	2,847
1884	229	227	256	298	311	244	268	145	89	59	73	66	2,265
1885	64	62	82	116	213	242	217	283	356	397	384	345	2,761
1886	270	280	291	328	343	365	357	313	253	272	221	185	3,478
1887	158	162	138	160	148	162	159	142	134	100	101	96	1,660
1888	57	52	56	49	56	97	82	96	132	229	307	302	1,515
1889	284	288	353	401	431	537	549	508	478	559	540	471	(*a*)5,435
1890	553	482	522	556	534	571	555	579	571	567	520	348	6,358

a Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

From this it will be seen that the total number of wells completed in 1890 was 6,358, as compared with 5,435 in 1889. This is the largest number of wells completed in these States in any one year.

In the following table is given the number of dry holes, that is, the number of wells drilled that produced no oil, in New York and Pennsylvania in 1889:

Number of dry holes drilled in the Pennsylvania and New York oil fields in 1889, by months and districts.

Months.	Bradford-Allegany.	Forest.	Warren	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.	Total.
January	6	2	5	47	2	2	....	2	66
February	4	....	1	56	1	2	....	2	66
March	7	....	2	41	1	1	....	7	59
April	1	....	6	57	10	2	....	3	79
May	8	....	4	48	5	10	....	8	83
June	8	1	3	60	6	15	3	3	99
July	4	2	2	46	6	21	....	10	91
August	3	....	(*b*) 5	45	7	5	....	2	68
September	10	....	3	38	3	2	7	4	67
October	13	1	1	45	6	6	3	3	78
November	7	3	6	36	11	2	....	3	68
December	10	....	1	27	8	5	....	....	51
Total	(*a*) 81	9	40	546	66	73	13	47	875

a Nine gas wells.

b One gas well.

The total production of the new wells completed during 1889 is shown in the following table:

Initial daily production of new wells in the Pennsylvania and New York oil fields in 1889, by months and districts.

[Barrels.]

Months.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.	Total.
January	219	11	133	1,254	730	200	....	230	2,777
February	296	10	79	1,500	473	544	....	140	3,042
March	291	12	187	1,666	4,048	275	....	25	6,504
April	396	8	169	1,686	1,100	183	30	245	3,817
May	454	24	340	1,561	2,594	818	....	140	5,931
June	529	85	344	2,055	3,152	588	15	425	7,193
July	643	65	232	1,590	2,815	1,387	....	100	6,832
August	757	68	306	2,501	3,246	469	....	365	7,712
September	652	15	217	2,427	2,433	270	660	10	6,684
October	905	84	495	1,981	1,883	292	235	243	6,118
November	854	60	342	2,710	1,761	800	1,080	500	8,107
December	867	86	366	1,882	2,062	397	552	322	6,484
Total	6,863	478	3,210	22,813	26,297	6,223	2,572	2,745	*a* 71,323

a Including 122 barrels in Franklin district, data for which by months were not obtainable.

The average daily production of the new wells completed in the Pennsylvania and New York oil fields from 1882 to 1889 is as follows:

Average daily product of the new wells in the Pennsylvania and New York oil fields from 1882 to 1889, by months and years.

[Barrels.]

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
January	19.50	22.40	13.70	40.00	13.50	25.50	15.43	13.08
February	19.40	14.90	15.00	41.30	13.40	44.75	12.48	10.50
March	22.25	22.50	17.00	23.30	22.90	29.75	66.00	19.70
April	22.00	21.00	12.00	40.00	32.00	43.50	9.40	15.17
May	21.30	17.50	18.00	23.00	38.60	22.00	68.71	12.00
June	36.80	15.00	17.50	10.60	25.00	38.51	40.55	13.50
July	108.80	15.00	59.30	10.30	31.10	18.14	14.38	13.20
August	84.20	13.80	22.60	10.60	51.90	49.30	19.00	15.50
September	25.75	14.40	41.70	13.20	62.40	57.70	19.00	14.14
October	15.90	14.20	165.50	14.00	28.00	25.98	13.72	11.50
November	12.90	13.80	87.40	10.90	28.00	19.69	12.80	15.20
December	20.40	11.80	92.60	10.90	23.00	11.40	13.30	14.25

It will be seen from this table that the average production of each well for 1889 is less than for any year covered by the tables.

In the following table is given the number of producing, flowing, and pumping wells in each district of Pennsylvania and New York at the close of 1888 and 1889:

Total number of producing, flowing, and pumping wells in the Pennsylvania and New York oil fields at the close of 1888 and 1889.

Districts.	Producing wells.		Flowing wells.		Pumping wells.	
	Dec. 31, 1888.	Dec. 31, 1889.	Dec. 31, 1888.	Dec. 31, 1889.	Dec. 31, 1888.	Dec. 31, 1889.
Bradford-Allegany	14,371	16,293	179	182	14,192	16,111
Forest	240	299	84	67	156	232
Warren	2,880	4,178	790	1,586	2,090	2,592
Butler-Clarion-Venango-Armstrong, etc.	6,138	8,336	28	308	6,110	8,028
Allegheny	176	298	160	36	16	262
Beaver and Smith's Ferry	199	270	3	14	196	256
Washington	618	1,232	108	186	510	1,046
Greene	193	231	6	19	187	212
Franklin	605	631	....	....	605	631
Total	25,420	31,768	1,358	2,398	24,062	29,370

From the above table it appears that the number of producing wells in Pennsylvania increased from 25,420 at the close of 1888 to 31,768 at the close of 1889, a total increase of 6,348, though the number of producing wells completed in Pennsylvania and New York in 1889 was but 4,560, leaving an excess of 1,788 wells to be accounted for in addition to the wells that were abandoned in the State during the year. This difference is no doubt due to the fact that a large number of wells which were shut in at the close of 1888, owing to the restriction of production before referred to, were not counted as producing wells. So also a number of wells that were not producing and practically abandoned at the close of 1888 were drilled deeper or cleaned out and became producers in 1889.

As the production of Pennsylvania for the month of December, 1889, was 2,055,247 barrels, it appears that the average production per well for that month was 64.7 barrels, an average of a little over 2 barrels a day. The average for the different districts varies greatly, but can be readily ascertained by dividing the production by the number of wells given above.

The amount of money expended for materials used in pumping, operating, and caring for wells in 1889, including fuel, materials for repairs, replacing old machinery, and materials, was $8,633,391. This is divided among the districts as shown in the following statement:

Value of materials used in pumping, caring for, and operating wells in the Pennsylvania and New York oil fields in 1889, by districts.

Districts.	Amounts.
Bradford-Allegany	$2,603,248
Forest	29,900
Warren	1,022,966
Butler-Clarion-Venango-Armstrong, etc	1,787,296
Allegheny	215,096
Beaver and Smith's Ferry	214,026
Washington	2,454,446
Greene	274,460
Franklin	31,953
Total	8,633,391

Well record.

	Number.
Total producing wells December 31, 1888	25, 420
Total producing wells December 31, 1889	31, 768
Total flowing wells December 31, 1888	1, 358
Total flowing wells December 31, 1889	2, 398
Total pumping wells December 31, 1888	24, 062
Total pumping wells December 31, 1889	29, 370
Wells completed in 1889	5, 435
Dry holes in 1889	875
Producing wells completed in 1889	4, 560
Initial daily production of new wells (barrels)	71, 323
Rigs building December 31, 1888	179
Rigs building December 31, 1889	422
Wells drilling December 31, 1888	273
Wells drilling December 31, 1889	610

Capital employed in producing crude petroleum in Pennsylvania and New York oil fields in 1889.—The total capital employed in producing crude petroleum in Pennsylvania and New York districts at the close of 1889, according to the table given below, was $89,562,008. Of this, $27,184,857 represented the value of land and $62,377,151 the value of all other property.

The total capital invested in Pennsylvania, the value of lands, and the total amount invested in all other property, by districts, are as follows:

Total capital invested in the production of crude petroleum in Pennsylvania in 1889, by districts.

Districts.	Total capital.	Total value of land.	Total value of all other property.
Bradford-Allegany	$32, 288, 195	$8, 562, 827	$23, 725, 368
Forest	1, 162, 174	648, 338	513, 836
Warren	10, 680, 618	3, 971, 524	6, 709, 094
Butler-Clarion-Venango-Armstrong, etc	26, 020, 574	8, 322, 204	17, 698, 370
Allegheny	2, 070, 926	739, 876	1, 331, 050
Beaver and Smith's Ferry	2, 203, 219	998, 055	1, 205, 164
Washington	12, 238, 107	2, 703, 816	9, 534, 291
Greene	2, 171, 763	978, 427	1, 193, 336
Franklin	726, 432	259, 790	466, 642
Total	89, 562, 008	27, 184, 857	62, 377, 151

The total amount of oil land owned and leased in the Pennsylvania and New York oil regions was 873,399 acres. Of this, 288,510 acres were owned and 584,889 leased. The value given to this land in the schedules was $27,184,857, an average value, ignoring fractions, of $31 an acre. The largest amount of land was held in the Butler-Clarion-Venango-Armstrong district, the smallest amount in the Franklin district. The highest average value per acre was in the Franklin district, being $53 an acre. The lowest value was in the Forest district, the average being $21 an acre. It is evident to any one at all acquainted with oil lands that these averages are very much below the actual value of this territory as oil land. This class of land is worth to-day all the way from $100 to $400 an acre. Recent purchases in the Bradford district, one of the oldest, have been as high, where the fee has been bought, as $150 to $250 an acre, while it is almost impossible to place a value upon oil lands in the Washington district or in several of the newer ones of the southwestern fields. As is stated elsewhere, land was bought in 1889 at a valuation of $1,500 for each barrel of daily production.

In leasing oil lands it is usual to pay a certain price for the lease, varying from $1 to $20 per acre, together with a certain proportion of the oil produced as royalty. This royalty varies from one-sixteenth to one-fourth of the oil produced, the almost universal custom being one-eighth. In estimating the worth of the oil land the value seems to have been put by the producer, so far as it relates to the leased land, at the amount paid per acre for the lease, while probably a fair price, though a low one, has been placed upon the land owned. It is evident, however, that this valuation is not a fair one, as certainly it should be estimated with some reference to the price paid for land when purchased in fee, having in consideration at the same time the amount of oil produced. Under these considerations it is believed that $100 an acre would be a very conservative estimate as the average value per acre of the owned and leased oil lands in Pennsylvania. At this figure the value of these lands would be $87,339,900, instead of $27,184,857.

The number of acres of land held as oil territory in the Pennsylvania and New York oil districts, together with the total value of the same and the value per acre, are as follows:

Statistics of land held as oil territory in the Pennsylvania and New York oil districts in 1889.

Districts.	Total acreage.	Owned.	Leased.	Total value of land.	Value per acre.
		Acres.	*Acres.*		
Bradford-Allegany	182,861	90,515	92,346	$8,562,827	$47
Forest	30,895	12,194	18,701	648,838	21
Warren	88,486	33,744	54,742	3,971,524	45
Butler-Clarion-Venango-Armstrong, etc	351,278	142,634	208,644	8,322,204	24
Allegheny	31,971	2,407	29,564	739,876	23
Beaver and Smith's Ferry	28,812	981	27,831	998,055	35
Washington	112,137	2,544	109,593	2,703,816	24
Greene	42,083	275	41,808	978,427	23
Franklin	4,876	3,216	1,660	259,790	53
Total	873,399	288,510	584,889	27,184,857	(a) 31

a. Average.

The total capital invested in the production of crude petroleum in Pennsylvania and New York, outside of that invested in lands, amounted in 1889 to $62,377,151. Of this, $55,936,194 was invested in wells, including rigs, wells proper, engines, boilers, casings, etc.; $1,327,614 in tanks; $7,255 in tank cars owned by the producers, but not including those owned by transportation companies; $1,268,928 in pipe lines at wells, but not including the lines owned by the pipe-line transportation companies; $446,305 in oil in stock at wells, and $3,390,855 in other property. One or two of these amounts demand some explanation. It should be distinctly noted that the value of tank cars and pipe lines given above does not include in any case the value of these properties owned by the various pipe-line and other transportation companies, but only the properties of the several kinds mentioned that were actually a part of the well outfit.

The total value of the wells, that is, rigs, wells proper, engines, boilers, and other apparatus, not including tanks, tank cars, or pipe lines, was $55,936,194. On the basis of 31,768 producing wells, this would give an average value of $1,761 per well. The average value of the wells in each district, as shown in the table of capital invested in them, is given below:

Average value per well in each of the districts in the Pennsylvania and New York oil fields in 1889.

Districts.	Amounts.	Districts.	Amounts.
Bradford-Allegany	$1,237	Allegheny	$4,297
Forest	1,360	Beaver and Smith's Ferry	4,202
Warren	1,335	Washington	7,428
Bulter-Clarion-Venango-Armstrong, etc	1,998	Greene	4,971
		Franklin	690

In the older districts it is customary to estimate the value of a well at the price at which the material at the well, including casings, rigs, engines, boilers, etc., could be sold. In the newer districts, especially in the southwestern country, a much higher estimate than this has been made, though even there it is believed that in arriving at the value sufficient account has not been taken of the income that the wells bring to their owners.

The number of producing wells at the beginning of 1889 was 25,420; at the close of 1889 it was 31,768. Assuming that the average number of producing wells throughout the year was in round numbers 28,000, they produced an average of 767 barrels, worth on the average in the neighborhood of $1.10 a barrel, or $844 per well. This number of wells (28,000), producing this value of oil in one year, should certainly be worth on an average more than $1,761, when the old materials from these wells will be worth from $1,250 to $1,500 in the upper region, and in the lower fields from $2,000 to $3,000. Some of the wells in the Washington district will probably produce from 50,000 to 75,000 barrels of oil before they are abandoned.

The capital invested in the production of crude petroleum in Pennsylvania and New York, outside of that invested in land, was as follows in 1889, by districts:

Capital invested in the production of crude petroleum in Pennsylvania and New York in 1889.

Districts.	Rigs, wells, engines, etc.	Tanks.	Tank cars.	Pipe lines.	Oil in stock December 31, 1889.	Other property.	Total.
Bradford-Allegany	$20,149,046	$534.594	$510	$681,549	$181,376	$2,178,293	$23,725,368
Forest	406,559	15,911	495	42,755	7,668	40,448	513,836
Warren	5,575,578	160,376	....	215,212	60,820	697,108	6,709,094
Butler-Clarion-Venango-Armstrong, etc	16,654,912	421,192	5,250	233.300	70,676	313,040	17,698,370
Allegheny	1,280,455	10,900	....	4,771	6,857	28,067	1,331,050
Beaver and Smith's Ferry	1,134,572	21,046	....	2,632	18,904	28,010	1,205,164
Washington	9,151,407	139,590	....	81,819	99,054	62,421	9,534,291
Greene	1,148,224	13,750	....	2,762	950	27,650	1,193,336
Franklin	435,441	10,255	1.000	4,128	....	15,818	466,642
Total	55,936.194	1,327,614	7,255	1,268,928	446,305	3,390,855	62,377,151

The totals of capital, acres of oil land held and its value, and the value of other property for the States of Pennsylvania and New York in 1889, were as follows:

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$89,562,008
Number of acres of oil land:		
Owned	288,510	
Leased	584,889	
Total acreage	873,399	
Present value of land, both owned and leased		27,184,857
Average value per acre, $31.		
Value of rigs, wells, engines, boilers, etc		$55,936,194
Value of tanks		1,327,614
Value of tank cars		7,255
Value of pipe lines at wells owned by parties making report		1,268,928
Value of oil in stock at wells December 31, 1889		446,305
Value of other property and improvements		3,390,855
Total		62,377,151

LABOR AND WAGES.

Census statistics of labor and wages.—The total number of persons reported as employed in the production of crude petroleum in Pennsylvania in 1889 was 19,832, to whom was paid $7,423,781 in wages. The number reported as foremen or overseers was 1,230; as mechanics, 10,049; as laborers, 8,256; as boys under 16 years of age, 156; as employed in offices, males 134, females 7.

While these statistics may correctly represent what they claim to give, namely, the persons actually employed in producing crude petroleum whose wages were paid by the different individuals, firms, or companies producing petroleum, they are misleading, and do not by any means represent the number of persons actually employed in building rigs, drilling wells, and building tankage and pipe lines in the oil regions. A great deal of this work is done by contract, building rigs at so much a rig or so much a foot, in drilling wells at so much a foot, or pumping wells at so much a day or so much a barrel. While the amounts so paid appear in a statement of payments for operating, pumping, and drilling wells, neither the number of men employed nor the amount so paid would appear under the head of wages paid for labor; nor is there any means of arriving at the total number of men so employed or their wages.

The classification of wages, though it is a general one in certain departments of the census, is unfortunate in the petroleum industry, as it is exceedingly difficult to classify the workmen engaged in drilling and operating wells under these classes. A pumper or engineer is neither a foreman, an overseer, a mechanic, nor a laborer, as the term "mechanic" is understood, meaning, as it does in the oil regions, usually a blacksmith, carpenter, or man engaged in a similar occupation. In some instances a pumper, who is the only workman at the well, has been classified as a foreman or overseer.

The division of employés in the table of classified wages given with each district is better than the list following, but as in many instances no return was made in the table of classified wages, the totals of the different employés given in these lists in no case equals the total number of employés given.

The total number of persons employed and the wages paid in the production of crude petroleum in Pennsylvania in 1889, so far as the same have been ascertained, are given in the following tables, by districts:

Classes of labor and wages paid in Pennsylvania and New York oil fields in 1889, by districts.

Districts.	Foremen or overseers.		Mechanics.		Laborers.	
	Number.	Wages.	Number.	Wages.	Number.	Wages.
Bradford-Allegany	432	$244,392	3,037	$913,488	2,709	$873,036
Forest	13	9,039	77	33,785	99	42,850
Warren	120	67,276	1,256	519,476	866	260,360
Butler-Clarion-Venango-Armstrong, etc	492	298,692	4,164	1,214,336	3,636	1,099,566
Allegheny	17	12,613	155	134,386	142	61,131
Beaver and Smith's Ferry	11	7,550	196	175,076	147	58,368
Washington	117	85,356	894	611,697	477	254,671
Greene	21	15,071	177	127,335	92	55,732
Franklin	7	4,685	93	12,837	88	42,739
Total	1,230	744,674	10,049	3,742,416	8,256	2,748,453

Classes of labor and wages paid in Pennsylvania and New York oil fields in 1889, by districts—Continued.

Districts.	Boys under 16 years.		Office.				Total number of employés.	Total wages paid.
			Males.		Females.			
	Number.	Wages.	Number.	Wages.	Number.	Wages.		
Bradford-Allegany	31	$6,587	45	$56,479	1	$360	6,255	$2,094,342
Forest	......	....	2	1,125	......	....	191	86,799
Warren	20	6,600	24	11,032	......	....	2,286	864,744
Butler-Clarion-Venango-Armstrong, etc	66	16,316	22	9,552	6	944	8,386	2,639,406
Alleghany	......	....	4	2,125	......	....	318	210,255
Beaver and Smith's Ferry	......	....	......	....	......	....	354	240,994
Washington	39	23,690	30	44,004	......	....	1,557	1,019,418
Greene	......	....	6	8,800	......	....	296	206,938
Franklin	......	....	1	624	......	....	189	60,885
Total	156	53,193	134	133,741	7	1,304	19,832	7,423,781

Employments of labor in Pennsylvania and New York oil fields in 1889, by districts.

Districts.	Building rigs.	Drilling wells.	Operating and caring for wells.	Torpedoing or cleaning wells.	Building or repairing tanks.	Building or repairing pipe lines.	Office.	Total wages paid.
Bradford-Allegany	$120,868	$548,558	$1,296,607	$44,153	$9,286	$18,031	$56,839	$2,094,342
Forest	5,015	31,849	45,547	110	1,562	1,591	1,125	86,799
Warren	81,048	393,668	333,848	23,248	11,830	10,070	11,032	864,744
Butler-Clarion-Venango-Armstrong, etc	161,908	1,097,416	1,826,976	21,230	18,406	2,974	10,496	2,639,406
Allegheny	8,919	117,977	79,565	....	1,669	....	2,125	210,255
Beaver and Smith's Ferry	27,696	126,409	82,989	....	3,900	....	....	240,994
Washington	66,780	373,689	464,846	12,882	52.950	4,267	44,004	1,019,418
Greene	3,277	75,747	101,191	3,572	10,590	3,761	8,800	206,938
Franklin	2,703	15,482	41,570	431	75	....	624	60,885
Total	478,214	2,780,795	3,773,139	105,626	110,268	40,694	135,045	7,423,781

The division of the $7,423,781 into amounts paid for various purposes shows that $478,214 was paid for labor engaged in building rigs, $2,780,795 in drilling wells, $3,773,139 in operating and caring for wells, $105,626 in torpedoing and cleaning wells, $110,268 in building and repairing tankage at wells, $40,694 in building and repairing pipe lines at wells, and $135,045 in the offices. The only figures that require much comment are those relating to the item of labor paid for drilling wells, which amounted to $2,780,795. This includes not only the amount paid for drilling new wells, but in many instances the cost of drilling and cleaning out old wells. The number of new wells drilled and completed in Pennsylvania and New York in 1889 was 5,435. Where this was done by contract the price ran from 40 cents to $1.50 per foot, the cost of drilling by contract including labor, fuel, wear and tear of tools, and use of machinery and appliances. Possibly 60 cents a foot would represent the cost of drilling a well, of which not much less than 40 cents would be the cost of labor. Assuming that the average depth of wells drilled in Pennsylvania and New York in 1889 was 1,200 feet, this would make the cost of labor per well in round numbers $500, making the total cost of labor in drilling the 5,435 wells drilled in 1889 $2,717,500. A portion of this sum should be added to the $2,780,795 given as the labor cost paid for drilling the same. Relative to drilling by contract, very full information on this subject has been received from Mr. J. L. Wilson, secretary of the Well Drillers' Association, of Titusville, Pennsylvania. Estimating the cost of wells in what is known as the Upper district, Mr. Wilson gives the following figures: Cost of rig, from $275 to $325; lumber in rig, from 8,000 to 10,000 feet, worth from $8 to $11 per thousand; iron, $70 to $80; timber, besides the lumber mentioned above, $30 to $50; carpenters' work and grading, $75 to $90; carpenters' wages, from $2 to $3.50 per day of 10 hours.

Relative to the cost of machinery, Mr. Wilson states that it is difficult to give exact information, as it is not known just how long machinery will last, its work being divided between drilling and pumping. Drilling machinery rents for drilling purposes, however, at from 10 to 15 cents per foot of drilling done, or from $50 to $75 for 30 days, the machinery including boiler, engine, pipes and fittings, belt, and bull rope. Boilers used in the oil region cost from $275 to $425, engines from $150 to $180, belts from $30 to $50, bull ropes from $15 to $20, and pipes and fittings from $5 to $10.

Drilling costs in the upper region from 40 to 50 cents per foot. This includes cost of labor, fuel, wear and tear of materials, and rent of tools, including ropes, the first cost of tools and rope being from $800 to $1,000. The depth of the new wells of the upper regions is from 600 to 1,000 feet, the time consumed in drilling being from 8 to 15 days of 24 hours each, drilling being continued night and day. The cost of labor is as follows: 2 drillers, at from $3 to $4.50 per day of 12 hours; 2 tool dressers, at from $2.50 to $3.50 per day; fuel, 4 to 5 cents per foot of well drilled, and casing from 30 to 45 cents per foot. The amount used is from 150 to 400 feet. Tubing used, according to depth of well, at from 13 to 17 cents per foot; fittings per well, $12 to $25; sucker rods, 5 to 7 cents per foot. The amount of sucker rods used is the same as tubing, varying with the depth of the well. The cost of drilling given above includes putting into the well the casing, tubing, and rods, but not the furnishing of them.

When the well is to be torpedoed, from 20 to 180 quarts of nitroglycerin are used, worth from 90 cents to $1 per quart.

The following is a condensed statement of the statistics of labor and wages for the entire States of Pennsylvania and New York in the production of crude petroleum in 1889:

Statistics of labor and wages in the Pennsylvania and New York oil regions in 1889.

All labor, not including office force:		
Number of foremen or overseers	1,230	
Total wages paid all workmen of this class in 1889		$744,674

Statistics of labor and wages, etc.—Continued.

All labor, not including office force—Continued.		
Number of mechanics	10,049	
Total wages paid all workmen of this class in 1889		$3,742,416
Number of laborers	8,256	
Total wages paid all workmen of this class in 1889		2,748,453
Boys under 16 years	156	
Total wages paid all boys under 16 years		53,193
Office force:		
Total number of males	134	
Total number of females	7	
Total wages paid males		133,741
Total wages paid females		1,304
Total number of persons employed and wages paid in 1889.	19,832	7,423,781
Wages paid for labor:		
In building rigs		478,214
In drilling wells		2,780,795
In operating and caring for wells		3,773,139
In torpedoing wells		105,626
In building or repairing tankage		110,268
In building and repairing pipe lines		40,694
In office		135,045
Total		7,423,781

OHIO.

In the three well-known districts, Lima, Macksburg, and Mecca, which make up the oil-producing territory of Ohio, the product in 1890 was 16,124,656 barrels, compared with 12,471,466 barrels in 1889. The statistics by districts and the value are shown in the following table:

Total production and value, and value per barrel, of petroleum produced in Ohio in 1889 and 1890.

Districts.	1889.			1890.		
	Total production.	Total value.	Value per barrel.	Total production.	Total value.	Value per barrel.
	Barrels.			*Barrels.*		
Lima	12,153,189	$1,822,978	$0.15	15,014,882	$4,504,465	$0.30
Macksburg	317,037	340,683	1.07½	1,108,334	1,127,730	1.01¾
Mecca-Belden	1,240	10,334	8.33⅜	1,440	12,000	8.33⅓
Total	12,471,466	2,173,995	0.17⅜	16,124,656	5,644,195	0.35

In the classification of this oil all of that produced in Lima was classed as fuel oil in 1889, that of the Macksburg district as illuminating, and all of that produced in the Mecca-Belden district as lubricating oil. This classification is correct with the exception of the Lima district. While it is true that most of the Lima oil that was consumed in 1889 was used as fuel, strenuous efforts were being made to find a method for refining it, so that considerable of the oil that was produced in 1889 and went into pipe-line stocks has since been used for illuminating purposes, the oil producing some 22 per cent. of illuminants, the balance being sold for fuel purposes. All of the oil produced in the Mecca-Belden district was used for lubricating purposes, and all of that produced in the Macksburg district was what may be termed refinery oil, or for manufacture into illuminating oil.

In 1890 a large proportion of the Lima oil was refined and supplied domestic consumption, while the exports of refined oils were supplied by the Pennsylvania and New York fields.

Bringing the production in previous years to the end of 1890, it is seen that the total product for the State aggregates 46,637,198 barrels, allowing, as has already been done, 200,000 barrels as the aggregate product previous to 1876.

Production of petroleum in Ohio.

	Barrels.		Barrels.
Previous to 1876	200,000	1884	90,081
1876	31,763	1885	650,000
1877	29,888	1886	1,782,970
1878	38,179	1887	5,018,015
1879	29,112	1888	10,010,868
1880	38,940	1889	12,471,466
1881	33,867	1890	16,124,656
1882	39,761		
1883	47,632	Total	46,637,198

The enormous increase in production shown in the above table began in 1885, which marks the commencement of developments in the Lima field. In 1886 this district yielded 1,064,025 barrels; in 1887 it increased four fold to 4,650,375 barrels; in 1888, to 9,682,683; in 1889, to 12,153,189; and in 1890, to 16,124,656, an amount greater than Pennsylvania and New York together had produced in any year prior to 1878.

Stocks.—The total stocks of oil held in Ohio December 31, 1888, were 10,243,066 barrels, of which 10,161,842 barrels were held by the pipe lines and 81,224 were held in stock at the wells. At the close of 1889 these stocks had increased to 14,886,122 barrels, of which 14,415,997 barrels were held by the pipe lines and 470,125 at the wells. In 1890 these stocks decreased to 10,000,000 at the close of the year; due to the increased refining at the wells, there was a slight increase to 500,000 barrels. The distribution of these stocks by districts is shown in the following table:

Stocks of petroleum in Ohio December 31, 1888, 1889, and 1890.

[Barrels.]

Periods.	Lima.	Macksburg.	Mecca-Belden.	Total.
December 31, 1888:				
Pipe-line stocks	9,810,714	351,128	....	10,161,842
At wells	78,118	2,726	380	81,224
Total at close of 1888	9,888,832	353,854	380	10,243,066
December 31, 1889:				
Pipe-line stocks	14,105,149	310,848	....	14,415,997
At wells	466,308	3,337	480	470,125
Total at close of 1889	14,571,457	314,185	480	14,886,122
December 31, 1890:				
Pipe-line and refining stocks	9,400,000	100,000	....	9,500,000
At wells	500,000	....	....	500,000
Total at close of 1890	9,900,000	100,000	....	10,000,000

From the preceding table it will appear that not only was all the oil produced in the Macksburg district in 1889 disposed of, but stocks were drawn on to the extent of nearly 40,000 barrels. The stocks in this district at the close of 1889 were actually 39,669 barrels less than at the close of 1888. On the other hand, stocks in the Lima district had increased 4,682,625 barrels, which would indicate a consumption of 7,470,564 barrels of Lima oil in 1889. It should be remembered, however, that reductions in stocks in the pipe lines do not always indicate actual consumption, as oil may be carried in tanks outside of those owned by the pipe lines.

The following statistics in regard to the number of wells and the capital employed in the Ohio oil industry were collected with great care and detail for the Census Office and are taken from the final report:

Wells.—"The total number of wells in all districts in Ohio at the close of 1889 was 2,640, of which 2,242 were in the Lima district, 390 in the Macksburg district, and 8 in the Mecca-Belden district. At the close of 1888 there were 1,788 wells in the State the increase in 1889 being 852. Of this increase, 777 were in the Lima field, 73 in the Macksburg, and 2 in the Mecca-Belden.

"During the year 1889, 759 producing wells are reported as having been completed. Of these, 667 were completed in the Lima district, 86 in the Macksburg district, and 6 in the Mecca-Belden district. The initial daily production of all of these wells was 55,930 barrels, an average of $73\frac{7}{10}$ barrels. The average initial production per well in the Lima district was $82\frac{1}{5}$ barrels per day; the Macksburg district, $13\frac{1}{10}$; the Mecca-Belden, one half barrel.

"The well statistics for the whole State of Ohio for 1889 are as follows:

Well record.

	Number.		Number.
Total producing wells December 31, 1888	1,788	Producing wells completed in 1889	759
Total producing wells December 31, 1889	2,640	Initial daily production of new wells (barrels)	55,930
Total flowing wells December 31, 1888	256	Rigs building December 31, 1888	26
Total flowing wells December 31, 1889	785	Rigs building December 31, 1889	59
Total pumping wells December 31, 1888	1,533	Wells drilling December 31, 1888	38
Total pumping wells December 31, 1889	1,855	Wells drilling December 31, 1889	45
Wells completed in 1889	825		
Dry holes in 1889	66		

Value of materials used in pumping, caring for, and operating wells in 1889, $650,503.

Capital.—"The total capital invested in the oil business in Ohio in 1889, according to the reports received, was $17,771,152. Of this, $9,963,302 represents the value of land and $7,807,850 the value of wells, tanks, pipe lines, oil in stock at wells, and other property and improvements.

"Of the total capital, as above stated, $16,802,637 was invested in the Lima district, $944,721 in the Macksburg district, and $23,794 in the Mecca-Belden district.

"Of the $7,807,850 invested in wells, etc., $6,627,835 was invested in wells proper, including the rigs, engines, boilers, etc.; $373,052 in tanks, and $123,762 in pipe lines at wells, not including those belonging to pipe-line companies; $76,063 represents the stock of oil at the wells on December 31, 1889, while $607,138 represents the value of other property, including cash and improvements.

"The total acreage of oil lands, both owned and leased, is 440,401. Of this, 23,513 acres are reported as owned and 416,888 acres as leased. The total value of this land, both owned and leased, is given as $9,963,302. This is but $23 an acre, ignoring fractions, for all the oil lands throughout the State. The value of the 371,619 acres of oil lands in the Lima district is given as $9,693,466, an average of $26 an acre; that of the 68,171 acres of land in the Macksburg district is stated to be $255,841, an average of only $4 an acre; while the value of the 611 acres in the Mecca-Belden district is $13,995, or an average of $23 an acre. It is evident, as has already been stated in connection with the general discussion of the value of oil lands, that this is an underestimate, the probability being that to the actual value of the land owned is added the actual amount of money paid for the leased land, and these two sums are taken as the total value of all the land. Even with Lima oil at the prices ruling in 1889, $100 an acre would be a very low estimate of the average value of the oil lands in the State of Ohio, and this amount would place these lands at $44,040,100, instead of a little less than $10,000,000.

"The total value of the wells, including rigs, engines, boilers, casings, etc., but excluding the tanks and pipe lines, as given below, is $6,627,835. Of this amount, $5,990,285 represent the value of the wells in the Lima district, $630,950 the value of those in the Macksburg district, and $6,600 the value of those in the Mecca-Belden district. This would make the value of each well in the Lima district $2,672, in the Macksburg district $1,618, and in the Mecca-Belden district $825. As has already been stated, it is the usual custom in oil districts to estimate the value of a well at about what the casing, etc., would be worth to remove to another well, and not by its producing capacity.

The consolidated statistics of the capital in all of the districts of Ohio are as follows:

Statistics of the capital employed in the Ohio fields in 1889.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$17,771,152
Number of acres of oil land:		
Owned	23,513	
Leased	416,888	
Total acreage	440,401	
Present value of land both owned and leased		9,963,302
Average value per acre, $23.		
Value of rigs, wells, engines, boilers, etc		6,627,835
Value of tanks		373,052
Value of pipe lines at wells owned by parties making report		123,762
Value of oil in stock at wells December 31, 1889		76,063
Value of other property and improvements		607,138
Total		7,807,850

Labor and wages.—In a general way it may be said that a large proportion of the work of building rigs, drilling and torpedoing wells, and erecting tankage is done by contract and the items for the labor in connection with these operations do not appear in this report; so also the general classification of foremen or overseers, mechanics, laborers, and boys is confusing and misleading, different proprietors classifying the same workmen under different heads, as, for instance, a pumper who has charge of the works at the well will be in some cases classed as a foreman, in others as a mechanic, and in others as a laborer.

The total number of employés at the oil wells in Ohio at the close of 1889 was 2,123. There was paid for labor by the proprietors of the wells, not including, as stated above, that paid drillers working by contract, $836,377. Of the employés, 1,798 were in the Lima district, 318 in the Macksburg, and 7 in the Mecca-Belden district. The amount of wages paid in the Lima district was $722,975, in the Macksburg $111,402, and in the Mecca-Belden district $2,000. There were 94 men classed as overseers, to whom $71,613 was paid in wages; 724 classed as mechanics, to whom $235,607 was paid, and 1,282 classed as laborers, to whom $509,421 was paid. No boys under 16 years are reported as having been employed at wells, and the total office force reported was 23, to whom $19,736 was paid in wages. This last item evidently includes only employés in offices, even if it includes all who are regarded as office force, and does not include owners, proprietors, or officers of companies.

The wages paid for labor in building rigs in Ohio, with the exceptions above noted, was $30,254; for drilling wells, $174,299; in operating and caring for wells, $595,518; in torpedoing wells, $3,728; in building or repairing tankage, $9,440; in building and repairing pipe lines, $3,402, and in the office, $19,736.

The statistics of labor and wages in the Ohio oil fields in 1889 are as follows:

Labor and wages.

All labor, not including office force:		
Number of foremen or overseers	94	
Total wages paid all workmen of this class in 1889		$71,613
Number of mechanics	724	
Total wages paid all workmen of this class in 1889		235,607
Number of laborers	1,282	
Total wages paid all workmen of this class in 1889		509,421
Office force:		
Total number (males)	23	
Total wages paid (males)		19,736
Total number of persons employed and wages paid in 1889	2,123	836,377
Wages paid for labor:		
In building rigs		30,254
In drilling wells		174,299
In operating and caring for wells		595,518
In torpedoing wells		3,728
In building or repairing tankage		9,440
In building and repairing pipe lines		3,402
In office		19,736
Total		836,377

Lima district.—Probably the most remarkable oil district ever developed in this country is that known as the Lima or Northwestern Ohio district. Its discovery opened up a new horizon (the Trenton limestone) as an oil-producer. Its development has been rapid since it first began to assume prominence in 1885, and its production has increased enormously. For a while it was believed that the character of the oil was such that no market could be found for it for illuminating purposes, but this theory has been exploded, and it is safe to predict that in the near future a large portion of the demand for illuminating oil, at least in the United States, will be supplied by the distillate from the limestone oil.

The Lima oil field, according to Professor Orton, who has written most fully upon it, constitutes a flat-lying tract of Trenton limestone. It is as near a level terrace as an area of this sort ever becomes. The very gentle slope that exists in it is mainly to the northward, not amounting to more than 4 feet to the mile, and at times reduced even to 1 or 2 feet. The rises in the floor, or, in other words, the knobs and bosses of this great limestone sheet, are always favorable to production, other things being equal. In this field are included all of the oil-producing districts in northwestern Ohio. They are generally divided into the Lima, Findlay, New Baltimore, Saint Mary's, Gibsonburg, Upper

Sandusky, and Spencerville fields. Oil was produced in this district in 1889 in Auglaize, Hancock, Mercer, Sandusky, and Wood counties.

The oil is found at Lima at a depth of 1,300 feet. It requires about sixty days to drill a well, the cost being some $2,500. The first wells drilled in this territory were none of them very large producers. Early in 1886 no well exceeded, if, indeed, any reached, 150 barrels a day. Toward the close of 1886 and the first of 1887, however, some very large wells were brought in, one being reported at 1,500 barrels a day, another reaching the 1,000-barrel limit, and others maintaining a rate of several hundred barrels per day week after week. In 1889 the average production of the new wells in this district was 80½ barrels, some wells yielding as high as 1,500 barrels and others dropping as low as 30 barrels, from 50 to 75 barrels being the most common figures of production.

The Lima oil and, indeed, all limestone oils differ greatly in character from the oils of the sandstones. They are dark or black and rather heavy, and contain sulphur compounds. In these respects the oils of northwestern Ohio resemble those of Canada and Tennessee. These oils, though they would be classed as rather heavy, differ greatly in specific gravity. In the first wells struck the oil had a gravity of 36° B.; in the later wells it reaches 37° or 38° and in some even 41°.

There have been two great drawbacks to the use of Lima oil for illuminating purposes: first, the presence of sulphur compounds; and, secondly, the yield as compared with the Pennsylvania oils. It is claimed that a way has been found to deprive this oil of its sulphur, and the price and market that are being obtained for the residuum after distilling off the illuminating oil have largely done away with the second objection. As is stated elsewhere, this oil has largely entered into use as an illuminator.

The production of petroleum in the Lima, Ohio, oil fields from 1886 to 1890 is as follows:

Production of petroleum in the Lima, Ohio, district from 1886 to 1890.

	Barrels.
1886	1,064,025
1887	4,650,375
1888	9,682,683
1889	12,153,189
1890	15,014,882

The statistics of the production of petroleum in the Lima field in 1889 are as follows:

Total production and value.

Total production in 1889 (barrels of 42 gallons)	12,153,189
Total value at wells of all oil produced, excluding pipage	$1,822,978
Value per barrel	$0.15

Stocks of fuel oil on hand at wells.

	Barrels.
December 31, 1888	78,118
December 31, 1889	466,308

Well record.

Total number of producing wells December 31, 1888	1,465
Total number of producing wells December 31, 1889	2,242
Total number of flowing wells December 31, 1888	157
Total number of flowing wells December 31, 1889	682
Total number of pumping wells December 31, 1888	1,308
Total number of pumping wells, December 31, 1889	1,560
Number of wells completed in 1889	701
Number of dry holes in 1889	34
Number of producing wells completed in 1889	667
Initial daily production of new wells (barrels)	54,800
Number of rigs building December 31, 1888	23
Number of rigs building December 31, 1889	57
Number of wells drilling December 31, 1888	33
Number of wells drilling December 31, 1889	38
Value of materials used in pumping, caring for, and operating wells in 1889	$318,000

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$16,802,637
Number of acres of oil land:		
Owned	22,477	
Leased	349,142	
Total acreage	371,619	
Present value of land, both owned and leased		9,693,466
Average value per acre, $26.		
Value of rigs, wells, engines, boilers, etc		$5,990,285
Value of tanks		355,157
Value of pipe lines at wells owned by parties making report		117,049
Value of oil in stock at wells December 31, 1889		69,946
Value of other property and improvements		576,734
Total		7,109,171

Labor and wages.

All labor, not including office force:		
Number of foremen or overseers	86	
Total wages paid all workmen of this class in 1889		$65,563
Number of mechanics	557	
Total wages paid all workmen of this class in 1889		183,210
Number of laborers	1,134	
Total wages paid all workmen of this class in 1889		454,826
Office force:		
Total number (males)	21	
Total wages paid (males)		19,376
Total number of persons employed and wages paid in 1889.	1,798	722,975
Wages paid for labor:		
In building rigs		$22,352
In drilling wells		129,638
In operating and caring for wells		537,201
In torpedoing wells		3,728

Wages paid for labor—Continued.	
In building or repairing tankage	$7,640
In building and repairing pipe lines	3,040
In office	19,376
Total	722,975

Classified wages.

Class of labor.	Number of each class.	Range of wages.
Foremen	81	$15 to $214 per month.
Pumpers or engineers	977	$5 to $75 per month.
Carpenters	48	$2.50 per day.
Rig builders	151	$60 to $125 per rig.
Drillers	276	45 to 80 cents per foot.
Tool dressers	5	$3 per day.
Laborers	186	$1 to $2 per day.
Teamsters	5	$3 to $5 per day.
Well cleaners	20	$3.50 to $5 per day.
Sundry mechanics	13	$2.25 to $2.50 per day.

Macksburg, Ohio, district—The second largest oil-producing district in Ohio, and the one producing oil that compares with the best product of Pennsylvania, is that known as the Macksburg district. The chief production of this district is in Washington county, but a large quantity is reported also from Noble county, and small amounts from Harrison and Belmont counties.

The development of the Macksburg district was almost coincident with that of the western Pennsylvania oil fields, the first well having been bored in 1860. This well was but 56 feet deep, and yielded many thousands of barrels of heavy lubricating oil. It is reported that at first the daily yield was from 100 to 200 barrels. A well a short distance west of this, yielded at first 150 barrels a day. Notwithstanding the early exploitation of this district, it however assumed but little importance until the spring of 1884, when a number of successful wells were bored. During 1885 the production increased rapidly, the runs through the Macksburg pipe line being 661,586 barrels. In 1890 the production reached 1,108,334 barrels, and this was the year of its greatest output.

The production of the Macksburg district for the last 6 years has been as follows:

Production of petroleum in the Macksburg, Ohio, district from 1885 to 1890.

	Barrels.
1885	661,586
1886	703,945
1887	372,257
1888	291,585
1889	317,037
1890	1,108,334

Though oil is produced from 4 sands in this field, the important one is the Berea grit. The first oil well in this formation was struck in 1878, and was a 10-barrel flowing well.

Search for oil in this horizon in 1889 was quite persistent. A dozen wells were drilled near Cadiz, several of which started with a production of from 5 to 10 barrels of oil per day, only a few maintaining a production of 4 or 5 barrels at the close of the year. In Belmont and Jefferson counties some work was done, but the result was, on the whole, somewhat unsatisfactory.

The statistics of the production of petroleum in the Macksburg district in 1889 are as follows:

Total production and value.

Total production in 1889 (barrels of 42 gallons)	317,037
Total value at wells of all oil produced, excluding pipage	$340,683
Value per barrel	$1.07½

Stocks of oil on hand at wells.

	Barrels.
December 31, 1888	2,726
December 31, 1889	3,337

Well record.

Total number of producing wells December 31, 1888	317
Total number of producing wells December 31, 1889	390
Total number of flowing wells December 31, 1888	98
Total number of flowing wells December 31, 1889	103
Total number of pumping wells December 31, 1888	219
Total number of pumping wells December 31, 1889	287
Number of wells completed in 1889	118
Number of dry holes in 1889	32
Number of producing wells completed in 1889	86
Initial daily production of new wells (barrels)	1,127
Number of rigs building December 31, 1888	3
Number of rigs building December 31, 1889	2
Number of wells drilling December 31, 1888	5
Number of wells drilling December 31, 1889	7
Value of materials used in caring for and operating wells in 1889	$331,255

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$944,721
Number of acres of oil land:		
Owned	745	
Leased	67,426	
Total acreage	68,171	
Present value of land, both owned and leased		255,841

Average value per acre, $4.

Value of rigs, wells, engines, boilers, etc	$630,950
Value of tanks	17,450
Value of pipe lines at wells owned by parties making report	6,695
Value of oil in stock at wells December 31, 1889	3,731
Value of other property and improvements	30,054
Total	688,880

Labor and wages.

All labor, not including office force:		
Number of foremen or overseers	8	
Total wages paid all workmen of this class in 1889		$6,050
Number of mechanics	167	
Total wages paid all workmen of this class in 1889		52,397
Number of laborers	141	
Total wages paid all workmen of this class in 1889		52,595
Office force:		
Total number (males)	2	
Total wages paid (males)		360
Total number of persons employed and wages paid in 1889	318	111,402

Wages paid for labor:	
In building rigs	$7,902
In drilling wells	44,661
In operating and caring for wells	56,317
In building or repairing tanks	1,800
In building and repairing pipe lines	362
In office	360
Total	111,402

Classified wages.

Class of labor.	Number of each class.	Range of wages.
Foremen	10	$40 to $75 per month.
Pumpers or engineers	111	$10 to $60 per month.
Carpenters	41	$2.50 per day.
Rig-builders	75	$50 to $205 per rig.
Drillers	131	45 to 60 cents per foot.
Tool-dressers	13	$2 to $3.50 per day.
Laborers	24	$1 to $2 per day.
Teamsters	3	$3 to $5 per day.
Sundry mechanics	8	$2.50 per day.

Mecca-Belden district.—The wells in this district are located in Lorain and Trumbull counties and include the Grafton and Mecca-Belden districts. All the oils in this district are from the Berea grit.

These districts produce a lubricating oil from a few shallow wells. The total production in 1889 was 1,240 barrels, worth at the railroad station, 3 miles distant, package included, from 30 to 35 cents, according to quality. There were eight producing wells in 1889, and all were pumped by heads. The oil is obtained mixed with water highly charged with hydrogen sulphide, as many as 1,000 barrels of water being often pumped out for one barrel of oil. The wells are owned and operated by farmers, who engage in this work when circumstances permit. The wells range from 50 to 60 feet deep, at which depth a fissure or crevice is found containing inexhaustible quantities of water, carrying a greater or less amount of oil. This water is collected and the oil permitted to settle, when it is skimmed off and, after settling, is heated by steam to still further drive off the water, and it is then put up in barrels and sold. A well was drilled in 1889 to a depth of 2,375 feet with the hope of obtaining a larger amount of oil, but without success.

There are no productive wells now in Mecca proper, all being in East Mecca.

WEST VIRGINIA.

The descriptions given in Pennsylvania of the Lower oil field, the character of the strata and of the oil produced, will apply to the Mount Morris and the Turkey Foot districts. That given in Ohio concerning the Macksburg district will apply to the Eureka. Regarding the other districts, it is sufficient to say that in most of the producing wells of the Volcano and Burning Springs districts the oil is found near the top of the carboniferous rocks.

Production.—The total production of petroleum in West Virginia in 1889 was 544,113 barrels, valued at $653,827, or $1.20⅛ per barrel; in 1890, 492,578 barrels, valued at $1.01¾ per barrel. In 1889 the Turkey Foot district produced 199,460 barrels; the Mount Morris, 174,758 barrels; the Volcano and Eureka, 165,735 barrels, of which 23,602 barrels were lubricating, and the Burning Springs, 4,160 barrels; making a total of 520,511 barrels of illuminating oil, valued at $595,730, or $1.14½ per barrel, and 23,602 barrels of lubricating oil, valued at $58,097, or $2.46⅛ per barrel. Tabulating these figures, the result is as follows:

Total production and value of petroleum produced in West Virginia in 1889 and 1890.

Districts.	1889.			1890.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.
	Barrels.			*Barrels.*		
Turkey Foot	199,460	$243,192	$1.21⅞			
Mount Morris	174,758	194,949	1.11½			
Volcano and Eureka	165,735	211,526	1.27⅝			
Burning Springs	4,160	4,160	1.00			
Total	544,113	653,827	1.20⅛	492,578	$501,198	$1.01¾

Production and stocks.—There are no separate reports of stocks of West Virginia oil held by pipe lines. The stocks held in Turkey Foot and Mount Morris are probably reported with the stocks of the pipe line in southwestern Pennsylvania, while the stocks of Eureka oil held by pipe lines are in the Macksburg report. There were, however, 6,104 barrels of oil in stock at wells December 31, 1888, and 6,835 barrels December 31, 1889. As the production of December, 1888, was 19,060 barrels, this would make the stocks at wells at the close of December, 1888, 32.03 per cent. of the production of that month. The production of December, 1889, was 81,453 barrels, and 6,835 barrels were held in stock at wells at the close of the month, making stocks at wells but 8.39 per cent. of the production for that month.

The general statistics in the Census report, referring to the West Virginia field are as follows:

The number of producing wells in West Virginia at the close of December 1888, was 505, and 623 at the close of December, 1889. Of the wells producing in this field at the close of 1888, eight were flowing and 497 pumping. At the close of 1889 there were 23 wells flowing and 600 pumping. The well statistics for the entire region are as follows:

Well record.

Items.	Turkey Foot.	Mount Morris.	Volcano and Eureka.	Burning Springs.	Total.
Total number of producing wells December 31, 1888	5	....	493	7	505
Total number of producing wells December 31, 1889	103	23	490	7	623
Total number of flowing wells December 31, 1888	....	....	7	1	8
Total number of flowing wells December 31, 1889	11	3	8	1	23
Total number of pumping wells December 31, 1888	5	....	486	6	497
Total number of pumping wells December 31, 1889	92	20	482	6	600
Number of wells completed in 1889	153	24	29	....	206
Number of dry holes in 1889	40	1	....	....	41
Number of producing wells completed in 1889	113	23	29	....	165
Initial daily production of new wells (barrels)	3,726	3,298	567	....	7,591
Number of rigs building December 31, 1888	2	1	2	....	5
Number of rigs building December 31, 1889	11	3	2	....	16
Number of wells drilling December 31, 1888	2	....	3	....	5
Number of wells drilling December 31, 1889	15	4	5	....	24
Value of materials used in caring for and operating wells in 1889	$92,254	$25,136	$5,379	....	$122,769

The total capital invested in oil production in West Virginia in 1889 was $1,472,598. Of this amount $411,663 represents the value of land and $1,060,935 the value of other property.

The amount of land held as oil land in this State is 120,219 acres, of which 396 acres were owned and 119,823 acres leased. The value of this land was $411,663, or, ignoring fractions, $3 an acre. To this amount should be added 17,630 acres of land leased for oil purposes on which no developments have been made, representing an outlay for leases of $10,243.

The total amount of capital invested in other property was $1,060,935. Of this amount $985,769 represents the value of rigs, wells, etc., $35,904 the value of tanks, $3,775 the value of pipe lines, $17,713 the value of oil in stock at wells, and $17,774 the value of other property.

As there were 623 producing wells in this State at the close of the year, and the value of these wells was $985,769, the value of each well would be $1,582.

The remarks made in Pennsylvania in discussing the question of land and value of wells will apply here also.

In the following table will be found a statement of the capital used in West Virginia, by districts, and its division into totals of land and other property:

Capital invested, by districts.

Districts.	Total capital.	Value of land.	Total value of other property.
Turkey Foot	$489,180	$188,173	$301,007
Mount Morris	501,254	142,111	359,143
Volcano and Eureka	476,028	80,718	395,310
Burning Springs	6,136	661	5,475
Total	1,472,598	411,663	1,060,935

The following table shows the acreage of land in each district in West Virginia, together with the value of the same and the value per acre:

Acreage and value of land.

Districts.	Owned.	Leased.	Total.	Total value.	Value per acre.
	Acres.	*Acres.*	*Acres.*		
Turkey Foot	50	32,295	32,345	$188,173	$5.82
Mount Morris	244	49,063	49,307	142,111	2.88
Volcano and Eureka	100	36,495	36,595	80,718	2.21
Burning Springs	2	1,970	1,972	661	.34
Total	396	119,823	120,219	411,663	*a*3.42

a Average.

In the following table will be found the division of the capital invested in West Virginia other than land:

Division of capital other than land.

Districts.	Rigs, wells, etc.	Tanks.	Pipe line.	Oil in stock.	Other property.	Value per well.	Total.
Turkey Foot	$291,210	$6,413	$620	$850	$1,914	$2,827	$301,007
Mount Morris	337,114	6,056	110	863	15,000	14,657	359,143
Volcano and Eureka	352,795	22,610	3,045	16,000	860	720	395,310
Burning Springs	4,650	825	....	....	....	664	5,475
Total	985,769	35,904	3,775	17,713	17,774	*a*1,582	1,060,935

a Average.

Labor and wages.—The total number of employés returned as engaged in the production of crude petroleum in West Virginia at the close of 1889 was 339, who were paid $160,974. The division of these workmen into classes and wages paid is as follows:

All labor, not including office force:

Number of foremen or overseers	17	
Total wages paid all workmen of this class in 1889		$14,520
Number of mechanics	213	
Total wages paid all workmen of this class in 1889		108,298
Number of laborers	107	
Total wages paid all workmen of this class in 1889		36,756

Office force:

Total number (males)	2	
Total wages paid (males)		$1,400
Total number of persons employed and wages paid in 1889	339	160,974

The character of work for which this total amount of wages was paid is shown in the following table:

Wages paid for labor.

In building rigs	$19,869
In drilling wells	82,312
In operating and caring for wells	55,903
In torpedoing wells	30
In building or repairing tankage	1,460
In office	1,400
Total	160,974

COLORADO.

Though indications of petroleum, such as oil springs, sandstones impregnated with petroleum, or with the residuum after evaporation, and "oozes," are reported from many parts of Colorado, the only locality from which oil has been produced in paying quantities is the field located in the valley of the Arkansas, near Florence, in Fremont county, known as the Florence field. This field extends from near Canyon, 8 miles above Florence, to an as yet undetermined distance southeast of Florence. The present productive field is confined to a small area, about 2 miles square, of the valley of the Arkansas river, and adjacent "mesa" or table land. It is reached by the Denver and Rio Grande and Atchison, Topeka, and Santa Fe railroads. The productive wells at present seem to be confined to a basin 1½ to 2 miles wide. East and west of this basin the petroleum is displaced by water. A notable spring of soda water was recently struck about 2 miles east of Florence at a depth of 2,200 feet, the water issuing from the ground at a temperature of 80° F. The length of this basin is northwest and southeast. What its extent is along its length is not as yet determined. The first wells, as will be seen below, were struck near Canyon, about 8 miles northwest of Florence. But these wells have been abandoned, and all the production is in the immediate vicinity of Florence. The drilling at the present time is chiefly toward the southeast from Florence, toward Pueblo, the larger bodies of land held by the different companies being in this direction. Wells have been bored near Pueblo, about 30 miles down the river, which have yielded water abundantly, but no oil. There is quite a stretch of country just below Florence which has the same geological structure as that in which the wells have been drilled. It is possible that the oil field may extend some distance down the river toward Pueblo.

As stated above, indications of oil have been found in many other places in Colorado. Beneath the Laramie deposit the Colorado group of the cretaceous formation consists of bituminous shales 1,600 to 2,000 feet in thickness. These have been disturbed in the vicinity of the mountains, and gas and oil have been found issuing from them in many places, as on the north branches of the San Juan river, in the coal basin below Glenwood Springs, and in the White River country. These bituminous shales of the Laramie have yielded, and probably will still yield, large quantities of petroleum. At Morrison, 11 miles from Denver, on the Denver and South Park railroad, the Denver Natural Gas and Oil Company is drilling for oil, encouraged by the presence of a sand rock colored dark brown or black by the residual products of the liquid hydrocarbons, which exists five-eighths of a mile west of the drilling point. The rock outcrops at this point, dipping about 30° east. Drilling was begun five-eighths of a mile east of the outcrop under the supposition that oil would be found at greater quantities at this depth. The drilling is in a shale, and was, in May, 1891, down to a depth of 1,950 feet, no oil having been reached at that time. The drilling of this well, known as the Morrison well, has been discontinued.

The first indications of petroleum in Fremont county were found at Oil Springs, about 6 miles northeast from Canyon and half a mile above the mouth of Oil Creek cañon. Mr. Joseph Lamb and other pioneers claimed to have seen the springs in 1859, but Mr. Gabriel Bowen is generally credited with the discovery. In 1862 the late Mr. A. M. Cassady purchased the springs from Mr. Bowen, and in March of the same year began collecting the crude oil by sinking 6 wells, first digging and sinking shafts, following with spring-pole and drill to a depth of 60 to 100 feet. Two wells were sunk from 300 to 500 feet, but oil was only found near the surface.

Between the years 1862 and 1865 Mr. Cassady collected and refined oil, most of which was transported by team and sold in Pueblo, Denver, and Santa Fé. For some of the refined oil he realized as high as $5 per gallon.

As Mr. Cassady's method of refining was crude and expensive, the advent of railroads across the plains from the Missouri river rendered his industry unremunerative and he abandoned it. Other parties at later dates attempted to sink wells in the same locality, but without success.

In 1881, while a well was being drilled near the coal mines at the town of Coal Creek for a water supply, oil was discovered at a depth of 1,260 feet. A company was organized, composed of citizens of Cañon City, called the Land Investment Coal and Oil Company, which commenced operations in November, 1882, and on April 7, 1883, after expending about $20,000, struck oil on the farm of Mr. Edwin Lobach, near the town of Florence, the present center of the oil industry of Colorado. This company was not successful, and in a few years was merged into the Colorado Oil Company, which company, with the

Arkansas Valley Oil and Land Company and other interests, organized the United Oil Company in 1887.

Other operations since the organization of the United Oil Company have been undertaken at Florence. The only one, however, operating in the census year was the Florence Oil and Refining Company. These two companies produced all the oil from this district in 1889. Four other companies, however, have since begun operations in this field, namely, the Rocky Mountain Oil Company, Triumph Oil Company, Colorado Coal and Iron Company, and the Beaver Land Company.

The geology of the country near Florence is very simple. The Arkansas valley at Florence has cut through the Laramie group, the upper member of the Cretaceous, exposing the upper portion of the Colorado group, the middle member of the Cretaceous. East and west of Florence the rocks of the Laramie, sandstones and shales, with beds of coal lying nearly horizontal, are exposed on the mountain side. In the valley at Florence, where the wells have been put down, the formation consists almost entirely of blue or bluish-black shale, having a thickness of from 3,000 to 4,000 feet. The wells are all sunk in this shale, no well that has yet been put down having passed through it, though some wells have been drilled 3,500 feet or more. Farther up the valley of the Arkansas these sedimentary strata are uplifted and rest against a granite axis of the Greenhorn range. The slate or shale in which the oil is found dips southwest about 10°. As stated above, the wells drilled in this district have never gone through the shale, which lies just below the drift, but it is questionable if the origin of the oil is in the shale. The indications are that it drains into the shale probably from the direction of Cañon City. It is noted in drilling that when the shale seems to be solid and unbroken no oil is found, but when in drilling, crevices are struck and the strata appears broken, oil is almost sure to be discovered. A well at a given point, which, when drilled, shows crevices and broken strata, may produce 150 to 200 barrels a day, while another well 100 feet from it, drilled through solid shale, will not give the least indication of oil. About one well in three has proved a producer.

The depth at which oil is found varies greatly. There are producing wells as deep as 1,960 feet, and others not over 1,000 feet. In one case there are two wells within 300 feet of each other, in one of which oil was found at a depth of 1,630 feet, and in the other no oil was found until 1,960 feet had been reached. The earlier wells of the Florence field were drilled 1,000 to 1,200 feet. In many cases these wells, after producing for a while, ceased, but upon drilling deeper they began producing again. No water is found in the wells after leaving the surface.

It will thus be seen that the conditions under which oil is found in Colorado are very different from those of its occurrence in Pennsylvania and Ohio. There are no pools as the word is understood in the East, but the oil seems to flow through the crevices or shattered strata to the drill hole. It is also a remarkable fact that the wells, instead of decreasing, actually increase in production. A certain well on the property of one of the companies, which began producing 90 barrels of oil, now produces 150, the maximum being reached within a short time after the well was struck, it gaining every day for about two weeks. Another well that began with a production of 100 barrels ran up in 5 days to 210, and has been producing at this rate for months. On the other hand, sometimes increase in production is very gradual, wells that are now several years old having recently increased their production. One well that started off producing 40 barrels in this way has recently run up to 150. The life of wells in the Florence district is also very long, and some wells have been remarkable producers, one having produced up to May 1, 1891, over 6,000,000 gallons. The large production and long life of the wells of this district may be due to the fact that it is a new field and comparatively few wells have as yet been put down.

It is also a fact that it does not hurt these wells to shut them down for a period. Often when the demand for oil has not been equal to the production the wells have been shut in, starting off again with full production when pumped. This will account for the variation in the number of producing wells shown in the table given elsewhere. This variation is not due to the drilling of new wells and the abandonment of old, but to stopping of production by shutting in the wells.

The Florence oil has a number of peculiarities as compared with Pennsylvania. It is a heavy oil, being about 31° B. It contains little or no lighter hydrocarbon, all the products that pass over in refining being sold as illuminating oil. Nor does the oil deposit any "B. S." It yields in refining about 35 to 44 per cent. water-white illuminating oils of about 125° fire test. There is little or no market for the residuum from refining other than fuel.

Product.—The following table gives the total product of all Colorado oil wells since 1887, when production first began, and includes all oil paid as royalty to owners of land upon which wells were drilled. There is no market in Colorado for crude oil, and none is bought and sold except a very small amount of royalty oil, which is pumped and bought by refineries, and is paid for at the rate of 2 cents per gallon or 84 cents per barrel.

Product of crude oil in Colorado from 1887 to 1890.

Years.	Barrels.
1887	76, 295
1888	297, 612
1889	316, 476
1890	368, 842

Stock of crude oil at wells.

	Barrels.
1888.	
December 31	13,092
1889.	
January 31	10,870
February 28	24,496
March 31	34,792
April 30	39,593
May 31	41,883
June 30	41,953
July 31	38,355
August 31	40,516
September 30	35,519
October 31	38,418
November 30	40,854
December 31	51,034
Average	36,524
Value of stock on hand at wells December 31, 1889	$45,267.56

The value of these stocks is calculated on the same basis as that of production.

Distribution of product.—There are no pipe lines or distribution lines used in Colorado. All oil produced is consumed by refineries. The per cent. of oil evaporated is very small.

Distribution of the Colorado oil product.

	Barrels.
Stocks at wells December 31, 1888	13,092
Produced in 1889	316,476
Total	329,568
Stock December 31, 1889	51,034
Distribution in 1889:	
Dump oil	277,211
Evaporated	1,323
Remaining on hand December 31, 1889	51,034
Total	329,568

Total number of rigs building but not completed.

[No rigs building in months omitted in 1889.]

December 31, 1888	3	July 31, 1889	1
January 1, 1889	2	August 31, 1889	1
February 28, 1889	1	September 30, 1889	1

Total value of materials used in building rigs, $3,600.

Total number of rigs completed.

[No rigs completed in months omitted in 1889.]

During—		During—	
January, 1889	3	July, 1889	1
February, 1889	2	August, 1889	1
March, 1889	1	September, 1889	1

Total cost of rigs built in 1889, $7,200.

Total number of wells drilling.

[No wells drilling in months omitted in 1889.]

December 31, 1888	4	July 31, 1889	2
January 31, 1889	3	August 31, 1889	2
February 28, 1889	1	September 30, 1889	2

Total value of materials used in drilling wells, $27,500.

Where dry holes have been drilled it frequently occurs that the rig is removed and another well started, thus reducing the cost of the following well.

The value of materials used in drilling wells is that of the tools and fixtures necessary to drill wells, and is not the value of materials used within the wells, such as tubing, casing, rods, etc.

Oil wells completed in Colorado in 1889.

Months.	Total number of wells completed in each month.	Number of dry holes.	Number of wells producing.	Initial daily production of new wells.
				Barrels.
January	4	3	1	8
February	3	2	1	50
March	1		1	50
April				
May				
June				
July				
August	2	1	1	90
September	2	1	1	12
October	1		1	50
November	1	1		
December				
Total	14	8	6	260

Out of 14 wells completed it will be noticed that 8 were dry holes, 6 only being productive. The average initial production of wells was 43⅓ barrels for the first 24 hours.

Number of producing oil wells in Colorado.

Months.	Total number producing. (*a*)	Total number abandoned.	Months.	Total number producing. (*a*)	Total number abandoned.
1888.			1889.		
December 31	23		July 31	22	
1889.			August 31	23	
January 31	24		September 30	24	
February 28	25		October 31	24	1
March 31	25	1	November 30	23	
April 30	12	3	December 31	22	1
1880.					
May 31	16		Total		6
June 30	15				

a All pumping.

Some wells, although productive, were shut down during the year on account of lack of storage and limited demand for crude product at the refineries. Six wells that had ceased to produce were cleaned, but without results. Thirteen other wells were cleaned with good results, bringing the production back to almost the original amount. No wells were torpedoed in this State during 1889.

Tankage.—The tankage in this State consists chiefly of cement and brick cisterns, it having been demonstrated that evaporation is less than if wood or iron tankage were used.

Statistics of oil tanks in Colorado.

Material.	Number.	Size.				Capacity. (Barrels of 42 gallons.)
		Diameter.		Height.		
		Ft.	*In.*	*Ft.*	*In.*	
Cement and brick	1	20	2	13	0	672
Do	1	25	0	12	0	1,300
Do	1	25	0	13	9	1,086
Do	13	31	8	9	6½	1,258
Do	1	30	0	13	4	1,511
Do	1	28	7	15	5	1,581
Iron	1	30	0	22	0	2,770
Do	1	59	11	28	0	14,204
Do	1	86	0	17	6	18,105
Wood	7					37
Do	15	10	0	8	0	100

Tank record.

Total number of tanks	43
Total capacity of tanks (barrels)	42,324
Total value of materials used in building or repairing tanks in 1889	$9,039
Total value of all materials used in building or repairing tank cars in 1889	$7,000
Total length of pipe lines at wells, not including that belonging to pipe-line companies (feet)	39,228
Total value of pipe lines at well	$7,904
Sizes of pipe used and length of each size:	
3-inch pipe (feet)	8,781
2-inch pipe (feet)	29,724
1-inch pipe (feet)	723

The amount of money expended for tankage at wells is really an expense for storage, and includes a limited amount of expense incurred from pipe lines at wells to refineries and storage cisterns.

The condensed statistics of the production of petroleum in Colorado in 1889 are as follows:

Total production and value.

Total production in 1889 (barrels of 42 gallons)	316,476
Total value at wells of all oils produced, excluding pipage	$280,240
Value per barrel	$0.88½

Stocks of illuminating oils on hand at wells.

	Barrels.
December 31, 1888	13,092
December 31, 1889	51,034

Well record.

Total number of producing wells December 31, 1888	23
Total number of producing wells December 31, 1889	22
Total number of pumping wells December 31, 1888	23
Total number of pumping wells December 31, 1889	22
Number of wells completed in 1889	14
Number of dry holes in 1889	8
Number of producing wells completed in 1889	6
Initial daily production of new wells (barrels)	260
Number of rigs building December 31, 1888	3
Number of wells drilling December 31, 1888	4
Value of materials used in pumping, caring for, and operating wells in 1889	$27,500

Capital invested in Colorado oil fields.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$3,000,000
Number of acres of oil land:		
Owned	33,015	
Leased	6,100	
Total acreage	39,115	
Present value of land, both owned and leased		2,517,215
Average value per acre, $64.		
Value of rigs, wells, engines, boilers, etc.		$229,659
Value of tanks		63,581
Value of tank cars		8,333
Value of pipe lines at wells owned by parties making report		7,903
Value of oil in stock at wells December 31, 1889		45,268
Value of other property and improvements		128,041
Total		482,785

Labor employed in producing Colorado oil.

All labor, not including office force:		
Number of foremen or overseers	5	
Total wages paid all workmen of this class in 1889		$4,950
Number of mechanics	56	
Total wages paid all workmen of this class in 1889		19,138
Number of laborers	28	
Total wages paid all workmen of this class in 1889		8,744
Office force:		
Total number (males)	1	
Total wages paid (males)		1,800
Total number of persons employed and wages paid in 1889.	90	34,632

Wages paid in producing Colorado oil.

Wages paid for labor:	
In building rigs	$2,703
In drilling wells	8,099
In operating and caring for wells	21,494
In building and repairing pipe lines	536
In office	1,800
Total	34,632

Classified wages.

Class of labor.	Number of each class.	Range of wages.	Average.	Days employed.
Foremen	4	$4.17 to $5 per day	$4.58	330
Pumpers or engineers	20	$2.50 per day	2.50	145
Carpenters	10	$3 per day	3.00	86
Drillers	8	$4 per day	4.00	127
Tool dressers	10	$3 per day	3.00	112
Laborers	38	$2 per day	2.00	115

CALIFORNIA.

The petroleum fields of California where oil is found in merchantable quantities are almost exclusively within the boundaries of the southern counties, though oil has been found in many other parts of the State.

The oil-producing territory in California in 1889 and 1890 may be divided into two general sections: (1) that included in the Santa Paula region, in which are found the Ojai, Sespe, Ex-Mission (which includes the Adams and other districts), the Torrey Cañon in the San Fernando mountain, 22 miles west of Newhall, the San Fernando district, including the Pico, Wiley, and Elsemere fields, and the Puente district, in which only one field, the Puente, is found; (2) the Santa Clara district, in Santa Clara county, which is known sometimes as Moody gulch.

The wells in the Santa Paula subdistrict of the southern fields are in Ventura county; the Pico and Puente subdistricts are in Los Angeles county.

Oil was at one time produced in San Mateo county, a short distance below San Francisco on the coast, and small amounts in other counties; but the only production in 1889 and 1890 was in Santa Clara, Ventura, and Los Angeles counties.

The oil belt commences near Santa Paula, in Ventura county, and extends thence in a southeasterly direction about 80 miles to Puente, in Los Angeles county, taking in the Sespe, Torrey cañon, and other wells in Ventura county, Pico, Newhall, Elsemere, Puente, and other districts in Los Angeles county. This belt has a variable width of from 2 to 3 miles, through oil is not found all through the entire length, it being apparently in pools.

Though petroleum has been known to exist in California from the time of its first settlement by the whites, no attempt was made to utilize the deposits until about the time of the discovery of the Pennsylvania oil fields, which led to the prospecting for petroleum at localities pointed out by petroleum and tar springs and by seepage from the asphaltum beds. During the years 1865 and 1866 upward of 70 companies were incorporated in California to search for petroleum and a large amount of money was spent, but no considerable amount of oil was found. The developments at this date were in Los Angeles and Ventura counties. Discouraged at the result of the first efforts, but little was done until 1875, when the business began to revive. In this year two wells were put down in the Pico cañon, which have been producers ever since. These two wells produced in 1875 about 650 barrels of oil. In 1877, 6,332 barrels were produced from the Ex-Mission field, and in 1878, 300 barrels were produced from the Santa Clara district. The first wells put down in the Pico cañon were drilled with spring poles. At least three wells were drilled in this way, two of which are still producing.

. The petroleum fields of California are the most interesting in the United States. In many respects they differ entirely from any other fields yet opened. The oil, with the exception of that from Santa Clara, has usually, as its "base", asphaltum instead of paraffin. The Pacific Coast Oil Company at one time pressed paraffin wax from the Santa Clara oil, but the low price of the wax and the reduction in the production of the crude compelled them to discontinue this production. The strata in which the oil is found are tilted at a high angle. Drilling is difficult and expensive, owing to the character of the rock and the angle at which the oil-bearing strata stand. The oil, while carrying but a small proportion of the illuminating hydrocarbons, finds a ready market as fuel, owing to the high price of coal in California, and it contains practically no "B. S."

While there is a certain general resemblance in all of the southern fields, there are certain important differences which make a description of each field of importance.

Describing the most northwesterly, the Santa Paula, first, it may be said that this field includes, as has been stated above, a number of small subdivisions, such as the Ex-Mission, Adams, Sespe, Ojai, Santa Paula, Torrey cañon, and others. These cañons are sharp ravines cut laterally in the sides of the mountains and usually at right angles with the course of the range. The strata in these various districts stand at an angle of about 75 degrees. In sinking wells the drills pass through shales until the oil sand is struck, which is from 2 to 40 feet in thickness. This sand is believed to be in the Tertiary strata, though of this there is some doubt. A red sand that used to be regarded as barren is now giving some very good wells.

The great angle at which the strata stand in this district makes drilling exceedingly difficult, resulting often in crooked holes, causing the drills to lodge in the wells and requiring torpedoing and reaming out and very expensive work in recovering them. This liability of the wells to become crooked suggested the employment of the diamond drill in boring. A well was bored in this way at Pico, but it was not a success, though a straight hole was secured. The fine mud that results from the use of the diamond drill seemed to fill up the interstices in the rock and prevented production. The reaming out of the well by a drill resulted in a very largely increased production. The same fact regarding the tilting strata also suggested the use of tunnels in producing petroleum. Some of the earliest work in mining for petroleum in California was by the use of tunnels. In fact, in the early history of this field and of all southern California prospecting for petroleum was by these tunnels, which were driven into the sides of the mountains where the surface indications, such as tar springs or seepage from asphaltum deposits, gave any prospect of getting oil. Many of these tunnels are still in existence and some are producing. One of these tunnels was driven in 1864 by a company of which Senator Stanford was a member. This produced at first 25 barrels of oil a day. Twelve years later the production had fallen to 8 barrels a day, and when Messrs. Hardison & Stewart purchased the property, in 1885, it was producing 5 barrels a day, and at the present time 2 barrels a day. This method of producing oil has never been in great favor in California. It is somewhat dangerous, as is all tunneling. It is known locally as "coyoting." There are many things, however, to commend it for these fields. As suggested above, the difficulty and expense of drilling, and especially the caving in of the wells, owing to the peculiar structure of the shale through which the wells are drilled, makes it difficult and expensive, not only to put down wells, but to case off the water. In these tunnels there is no caving in of strata, no casing, no pumping, and in fact, no expense after the tunnel is once driven. The first or Stanford tunnel was driven 350 feet. One driven some four years ago was 625 feet long. The oil was found in different strata, and paid for it before it was finished. The yield of this tunnel was about 60 barrels a day when first finished; now it is 8 barrels a day. The cost of driving these tunnels is from $5 to $10 a running foot. The wells cost as much as this at times. The size of the tunnel is usually 4 by 6 feet. In 1889 there were 4 of these tunnels producing.

Another peculiarity of these wells, growing out of the tilting of the strata above referred to, is the great increase in the production of different wells put down to reach the strata at different depths. As has already been stated, these strata dip about 75 degrees. A series of five wells has been put down at one place in the Adams cañon, the wells being started on the surface at different heights up the mountain side above the stream at its base. The first well was put down a short distance above the point where the oil-bearing rock came to the surface, the presence of the oil showing itself by seepage from the outcropping rock. The sand rock was struck at a depth of 110 feet, and produced 20 barrels a day. The second well was started a little higher up the mountain side, the rock pitching toward the mountain, striking the oil-bearing rock at a depth of 130 feet, giving a production of 25 barrels a day, draining or perhaps better, stopping production entirely in No. 1. A third well was started still farther up the mountain side, which struck the rock at a depth of 330 feet, producing 75 barrels a day and stopping production in the second well. A fourth well, started still higher up the mountain side, struck the rock at a depth of 682 feet and started off producing 300 barrels a day, stopping production in No. 3. The fifth well is being put down very much higher up the mountain, but had not struck the sand rock at the time this report closed, though it had been drilled to a depth of 2,450 feet. The fourth well described above produced up to a given period 123,000 barrels, the production of the four wells being for the same time 250,000 barrels. Another peculiarity is noticed in these wells. Sometimes the depth of shale is very slight, the well being drilled entirely through sand (not sand rock), a little oil being produced all the way down. It is customary to case the well and perforate the casing, the oil flowing in from the sand almost the entire depth of the well. In a short time, however, the sand packs around the casing, the oil begins to percolate through it, and, to use the expression of the region, the well "gets its pace and is a stayer."

The oil of the Santa Paula field produces about 15 per cent of distillate; 35 per cent can be secured, but the quality of the illuminant is not satisfactory. But little oil from this district is refined, most of it being sold for fuel purposes. The gravity is from 16° to 32°, the average being about 26°. The oil from the same region differs greatly in its character. In putting down wells up the sides of a hill, six or seven different grades of oil will be found in as many ledges. In one case six wells were put down, beginning at the bottom of the hill and going up the sides 400 feet. In the first well, going up the hill, a black oil of 26° gravity was found; in the second well the oil was black and of 28° gravity; in the third it was a heavy oil and brown; in the fourth well the oil was 18° gravity, tarry and black; in the fifth well the gravity was 18°, heavy and green, and in the sixth well the gravity was 30° and the oil was light green in color with some yellow.

The strata in the other districts are not pitched as in the Santa Paula, where they stand at an angle of some 75 degrees. In the Pico field they are 65 degrees, and in the Puente 30 degrees. This excessive tilting makes drilling difficult and expensive. Not only are the strata very much tilted, but they are so much so all through southern California that but little dependence can be placed in their continuity. This resulted in the early history of mining for oil in California in the spending of very large sums of money, but with very little result, but in later years it has led to very cautious explorations. It also has resulted in very small fields, with the exception of the Santa Paula. In this field there are practically continuous deposits for a distance of some 40 miles, though the deposits are in pools. The Pico producing field is but a few hundred feet, possibly a mile in length by 700 or 800 feet broad, though developments are being made for 8 miles, while the Puente, as developed, is but 3,500 feet long by 800 feet broad. This also is probably much larger.

Many of the conditions existing in the Pico cañon are similar to those in the Santa Paula district; but there are many conditions that are more manifest here than in Santa Paula. The San Fernando district, as stated above, comprises three subfields, the Pico, which is the most important, the Wiley, and the Elsemere, which are recent developments. The Pico field is some 7.5 miles west of Newhall, which is on the Southern Pacific railroad; the Wiley some 5.5 miles southwest, and the Elsemere 2.5 miles to the southeast. These are all connected with Newhall by pipe lines.

As has already been stated, drilling was begun in this field in 1875, August 22, being the date of the beginning of the first well, which was finished September 8. This well was drilled to a depth of 120 feet with a spring-pole. At the depth of 30 feet oil was struck in a shale, giving a production of 2 barrels a day. At the depth of 120 feet oil was found, also in shale, the production being 10 to 12 barrels a day. In 1887 this well was deepened with modern drilling tools to a depth of 600 feet. At a depth of 175 feet the well produced by pumping 30 barrels a day. In 1882 this well was still further deepened to 735 feet, but there was no increase in production. The best sand was found in this well at a depth of 170 feet. Well No. 2, very close to No. 1, was drilled in November, 1875, also with a spring-pole. The best sand was struck at a depth of 250 feet, the well flowing from 20 to 25 barrels a day. At 520 feet the production was 40 barrels, the well being pumped. In well No. 3, sand producing 4 barrels a day was struck at 90 feet, another at 145 feet producing 8 barrels a day, while at 170 feet one producing 11 barrels a day was struck. In well No. 5 the first oil-producing sand was struck at 900 feet, while in No. 7 sand was found at 850 feet, giving a flowing well. The deepest producing wells in this district are from 1,400 to 1,730 feet.

The same difficulty in drilling wells exists here as in the Santa Paula district. The wells are put down on the sides of very steep cañons, requiring very expensive work in securing a level place to begin drilling, oftentimes requiring blasting in the mountain sides. Crooked holes are not infrequent, and it is nothing uncommon for wells to cost from $6,000 to $20,000 apiece. Contracts have been taken in this district to put down wells at $6 a foot, the company owning the land furnishing fuel, water, and casing. The wells in this district never suffer from drowning out by water. Though some of the wells produce both water and oil, the average proportion of water to oil is very small. In some wells the water contains material in solution that eats the casing, making it thin, like paper. In this district as in others, considerable gas is found in the wells, which is utilized for pumping and drilling, saving possibly in this district 20 tons of coal a day. Wells are never shot for production. Sometimes when a hole is crooked and tools are stuck in them they are shot to release the tools, but not to increase the yield of oil.

The oil of the Pico field is in some respects better than that of the other fields, some of it containing a little paraffin occasionally, and it yields a larger percentage of illuminants in refining than the Santa Paula oil, crude being about 40° gravity. In the Wiley subdivision of the Pico field two different oils are found, taken from the same well, a green and a black. The production of these two oils is about 4½ barrels a day, and was found at a depth of from 600 to 800 feet. In drilling this well sand, not sandstone, was struck at a depth of from 400 to 600 feet. This sand followed the drill up the well fully 50 feet. It is from this sand that the oil comes. It had to be shut off from the well by casing and the casing perforated. A similar phenomenon is noticed in the Santa Paula district.

The Elsemere field was not developed until after the close of 1889.

The Puente field is located in the Puente hills, 7 miles from Puente station, on the Southern Pacific railroad. Oil in some instances is found in a shale just above the sand, but mostly in the sand. It has asphaltum as its base, carrying about 15 per cent. Wells are struck at various depths, but the best producers begin at 500 feet. It is difficult to drill below 1,200 feet, owing to the caving in of the strata, noticed in connection with the remarks on other fields. One well has been drilled in this district to a depth of 1,200 feet, but the deepest producer is at 1,000 feet. The strata are very much pitched and broken, dipping about 30 degrees north, the strike being a little northwest of west. The field as at present developed is 3,500 feet long by 800 feet wide. The first well was drilled in this field in 1883. The occasion of drilling the well was the discovery of a large amount of seepage near where the well was first put down. No. 2 and No. 3 were drilled early in 1884, and no others were drilled until 1886. The earlier wells up to No. 3 were drilled to the depth of 200 feet, and produced a heavy oil to the amount of 3 or 4 barrels a day. These are still producing, but in smaller amounts, from 1 to 2 barrels daily. No. 4 well, which was drilled in 1886, was also a small producer, yielding 15 barrels a day. No. 5, drilled in 1886, began with a production of 75 barrels. Three wells were drilled in 1888 and three in 1889. The same difficulty in drilling noted in other districts in this State obtain here also, such as crooked holes, caving in of sides, losing of tools, etc. The cost of drilling is from $3 to $6 a foot or more. In this district what is known as stovepipe casing is used. This is a thin riveted casing, two joints being put together, one being smaller than the other. The inner casing on one end projects beyond the outer casing, while the outer casing projects at the other end beyond the inner, forming a socket at one end, into which the projection at the other fits. The casing is ticked together at the joints, requiring no nuts or screws or couplings. The casing is sometimes jacked down into place. All of the oil from this district is piped over the hills to near the Puente station, loaded in tank cars and sent to Los Angeles, and consumed for fuel. No dry holes have ever been found in this district. Every well that has ever been sunk was a producer and is still producing. The wells are all pumped by heads. Though one or two spouters have been struck, they soon dropped in production and are now pumping. The following is an analysis of various tests made of the oil from these wells, having a gravity of 32°:

Analysis of oil from the Puente field, California.

	Per cent.
Benzine, from 80° to 58°	15
Illuminating, 58° to 42°	26
Lubricating, 42° to 30°	14
Lubricating, 30° to 24°	27
Asphalt (maltha)	18
Total	100

Statistics of production of petroleum in California in 1889 and 1890.—In the table given below are the consolidated statistics of the production of petroleum in California in 1889. From this it appears that the total production was 303,220 barrels, of which 97,264 barrels were classed as illuminating and 205,956 barrels as fuel oil. The probability is that a small proportion of that oil classed as fuel oil was also sold to refineries, but the division named is the best that was possible under the circumstances. The illuminating oil was priced at $1.25⅛ per barrel at the well, the fuel at $1.13¾. Some of this oil classed as fuel oil was a very heavy oil carrying a large percentage of asphaltum, and was sold as a paint for painting iron pipes. A small portion of the oil classed as illuminating was sold for mixing with asphaltum for thinning or tempering it, as it is termed. This oil brought 20 cents a gallon. These amounts in each case, however, were so small that they may be ignored and the classification allowed to stand.

Production of oils in 1889 and 1890.

Kinds of oil.	1889.	1890.
	Barrels.	*Barrels.*
Illuminating	97,264	98,360
Fuel	205,956	209,000
Total	303,220	307,360

Value at wells of all oil produced, excluding pipage, in 1889 and 1890.

Kinds of oil.	1889.		1890.	
	Total value.	Value per barrel.	Total value.	Value per barrel.
Illuminating	$121,684	$1.25⅛	$121,701	$1.23
Fuel	234,364	1.13¾	262,499	1.25
Total	356,048	1.17⅜	384,200	1.25

Concerning the other statistics but little need be said. It has been exceedingly difficult to collect these figures, and even now there is some doubt as to their accuracy. The business of producing crude petroleum in southern California is so complicated in certain fields as to lead to possible duplication of returns in some instances and to insufficient returns in others. It is believed, however, that the statements given in this report are nearer correct than those usually published regarding the production of crude oil in California, being the result of a personal visit by the writer to the field.

Stocks of oil on hand at wells.

	Barrels.
December 31, 1888:	
Illuminating	1,758
Fuel	5,789
Total	7,547
December 31, 1889:	
Illuminating	1,264
Fuel	2,176
Total	3,440

Well record.

Total number of producing wells December 31, 1888	88
Total number of producing wells December 31, 1889	89
Total number of pumping wells December 31, 1888	88
Total number of pumping wells December 31, 1889	89
Number of wells completed in 1889	10
Number of dry holes in 1889	4
Number of producing wells completed in 1889	6
Initial daily production of new wells (barrels)	76
Number of rigs building December 31, 1888	2
Number of rigs building December 31, 1889	1
Number of wells drilling December 31, 1888	3
Number of wells drilling December 31, 1889	2
Value of materials used in caring for and operating wells in 1889		$51,680

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$2,186,958
Number of acres of oil land owned	10,607	
Present value of land		1,060,000
Average value per acre, $100.		
Value of rigs, wells, engines, boilers, etc		$840,164
Value of tanks		11,250
Value of tank cars		40,000
Value of pipe lines at wells owned by parties making report		61,257
Value of oil in stock at wells December 31, 1889		4,036
Value of other property and improvements		170,251
Total		1,126,958

Labor and Wages.

All labor, not including office force:		
Number of foremen or overseers	5	
Total wages paid all workmen of this class in 1889		$8,000
Number of mechanics	25	
Total wages paid all workmen of this class in 1889		18,147
Number of laborers	62	
Total wages paid all workmen of this class in 1889		46,284

Office force:		
Total number (males)	3	
Total wages paid (males)		$2,625
Total number of persons employed and wages paid in 1889	95	75,056

Wages paid for labor:	
In building rigs	3,195
In drilling wells	20,131
In operating and caring for wells	49,055
In building or repairing tankage	50
In office	2,625
Total	75,056

Classified wages.

Class of labor.	Number of each class.	Range of wages.
Foremen	6	$100 to $200 per month.
Pumpers or engineers	9	$65 to $80 per month.
Carpenters	7	$3 to $4 per day.
Drillers	18	Do.
Laborers	58	$1.50 to $3 per day.
Sundry mechanics	2	$2.50 to $4 per day.

INDIANA.

Although reports of the discovery of oil in Indiana were rife in 1889, the only production in this State concerning which statistics have been secured was at Terre Haute, in Vigo county, and at Montpelier, Blackford county. The notable developments in Indiana have all been subsequent to that year.

On May 6, 1889, oil was struck in the Diall well at Terre Haute. The flow was estimated at 1,000 barrels per day, but its production rapidly declined, the total production for the eight months after the well was struck being but 30,000 barrels, an average for the entire time of 3,750 barrels a month, or about 125 a day. At the close of the year it was estimated that the production did not exceed 75 barrels a day. The excitement following this find, which was in some respects unlucky, was intense. Company after company was formed, and over $60,000 was expended in exploiting for oil. Up to the close of the year only one producing well in addition to the Diall had been struck. This was a small producer, rated at first as a 50-barrel well, but averaging in December only 15 barrels a day. The oil in these wells is found in the upper part of the Hamilton limestone at a depth of 1,615 feet. The other locality in which oil was found in 1889 was in Montpelier, Blackford county. During that year two wells were drilled at this point. The well drilled by the citizens of the place as a company was intended to demonstrate the presence of oil or gas, and, finding oil, the well was plugged and as late as April, 1891, no use had been made of the product. A well was also drilled at the same place by a firm composed of residents of Montpelier and some oil was secured. The production in 1889, however, was very small. This product is used on the spot for burning under a boiler at a stone quarry, and occasionally a tank car is sold to one of the fuel companies. In this case the price of Lima crude controls the market. The oil is of a dark color, is supposed to be a limestone oil, but has not the sulphurous odor peculiar to the limestone oil from Lima. At the close of the year developments were being pursued in this district with good prospects of securing a supply of oil. Some interest was also being taken in a territory at Keystone, Wells county, 3 miles north of Montpelier, in a section which it was assumed was a continuation of the Montpelier district, and in 1890 some wells were struck and the district gave great promise of becoming an important one in the future.

At Dundee, Madison county, about 6 miles west of Montpelier, and at Bryant, southeast of Montpelier, there are also indications of oil. This whole territory can be named the Montpelier district, from the point at which oil was first struck.

The statistics of the production of petroleum in Indiana in 1889 are given as follows:

Total production and value in 1889 and 1890.

	1889.	1890.
Total production (barrels of 42 gallons)	33, 375	63, 496
Total value at wells of all oil produced, excluding pipage	$10, 881	$32, 462
Value per barrel	$0. 32⅗	$0. 51⅛

The stock on hand at the wells December 31, 1889, was 12,250 barrels of fuel oil.

Well record.

Total number of producing wells December 31, 1889	3
Total number of flowing wells December 31, 1889	3
Number of wells completed in 1889	3
Number of producing wells completed in 1889	3
Initial daily production of new wells (barrels)	1, 135
Number of rigs building December 31, 1888	1
Value of materials used in pumping, caring for, and operating wells in 1889	$15, 777

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		(*a*)$49, 918
Number of acres of oil land leased	12, 585	
Present value of land		5, 528

Average value per acre, $0.44.

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a In addition to the above, information has been received of the expenditure of $54,874 in the drilling of 17 wells in Vigo county, all of which were dry holes. Of this amount $51,524 is reported as absolutely lost.

Value of rigs, wells, engines, boilers, etc	$15,650
Value of tanks	10,335
Value of tank cars	5,800
Value of pipe lines at wells owned by parties making report	2,130
Value of oil in stock at wells December 31, 1889	4,075
Value of other property and improvements	6,400
Total	44,390

Labor and wages.

All labor, not including office force:		
Number of foremen or overseers	1	
Total wages paid all workmen of this class in 1889		$1,200
Number of mechanics	7	
Total wages paid all workmen of this class in 1889		725
Number of laborers	25	
Total wages paid all workmen of this class in 1889		4,105
Office force:		
Total number (males)	1	
Total wages paid (males)		50
Total number of persons employed and wages paid in 1889.	34	6,080

Wages paid for labor:	
In building rigs	$125
In drilling wells	600
In operating and caring for wells	5,305
In office	50
Total	6,080

Classified wages.

Class of labor.	Number of each class.	Range of wages.	Days employed.
Foremen	1	$150 per month	240
Rig builders	3	$125 per rig	
Drillers	4	60 cents per foot	
Laborers	1	$25 per month	
Sundry mechanics	22	$75 per month	

KENTUCKY.

The only petroleum produced in Kentucky in 1889 was from the Boyds Creek district, in Barren county, some 3.5 miles from Glasgow. From January to August five wells were operated in this district, and six from August to the close of the year. Some 5,400 barrels were produced, which were distilled (it could hardly be called refined) by the operator in a still near the wells, and the distillates sent to Louisville to be refined. The naphtha and residuum were also shipped to the Louisville refinery.

Near Sumerset, Pulaski county, oil was struck about 85 feet below the surface. The oil sand was drilled into to a depth of 45 feet, and it was in this rock that the oil was procured. Just before boring this well the same operators bored another at a point 4 or 5 miles northeast, in which the same oil-bearing rock was struck near the surface; there was, however, barely a showing of oil. The results obtained in drilling these wells convinced the operators that the dip of the oil-bearing sand rock was in a southwesterly direction, and their opinion is substantiated by the fact that many years ago some wells were developed at a point 40 miles southwest of the second well referred to. The well first referred to was plugged after some 3 or 4 barrels had been obtained, the operators concluding that to obtain oil in paying quantities they would have to go farther southwest.

This oil has been tested by Prof. W. Dicore, of Cincinnati, Ohio. It shows a specific gracity of 0.870 of 43½° B., and on distillation 5 per cent. of light oil boiling below 130° F., 18 per cent. of light oil boiling at from 130° to 300° F., and 34 per cent. of illuminant of 48° gravity B. After these are taken off a lubricating oil of 28° B. is obtained, which, on further heating, yields oil of 39° B., out of which 17 per cent. of heavy lamp oil of 43° can be produced, increasing the total of lamp oil to 51 per cent. The remainder is a lubricating oil (of a consistency like linseed oil) of 22° B., flashing at 330° F. The color of the crude oil is a greenish brown, and the odor not more offensive than that of well purified gasoline. There is no sediment or inorganic substance, nor a separation of the higher hydrocarbons after long standing.

In Russell county some 15 or 16 years ago (1874) a refinery was operated by some parties who also had a well at the same location, but during their operations there was a great depression in the price of oil, and, coupled with the burning of their tank and the fact that they had no means of transporting their product, except in wagons for a long distance in order to reach railway transportation, they could not make the continued operation of their well profitable. It was therefore abandoned and the well plugged. The oil is still there and can be seen seeping from the hole, and is of the same character as the oil found near Somerset. About the same time that this refinery and well were operated in Russell county there were some wells bored in Cumberland county, which adjoins Russell county, but they were also abandoned about the same time that the Russell county operators ceased, and for similar reasons, namely, lack of transportation facilities and depression in the price of oil. Early in 1890 there was one well being drilled in Cumberland county and three rigs in course of construction for the purpose of further development, and it was said that there would be ten or twelve rigs at work in this and Russell counties during the earlier months of that year. Natural gas in considerable volume was struck early in January, 1890, in Cumberland county, but was cased off, since the operators wished to continue drilling for the purpose of finding oil, for which there was every prospect of success.

Wayne county also had producing oil wells in former years, which likewise were abandoned for the lack of transportation and the failure of the company prosecuting the development.

In all there are upward of 70,000 acres of land under lease for oil purposes in Pulaski, Wayne, Russell, Clinton, and Cumberland counties, to which that under lease in Barren county should be added. Operations are being energetically pushed in Barren county, which lies west of Russell and Cumberland counties, and a refinery was being erected near Glasgow late in 1889. Wells completed in this county, however, were not found to exceed 15 barrels daily production.

A little heavy, dark oil, with weak brine, has been found at a depth of 70 feet near Lexington, in the Trenton rock. Near North Middletown, Bourbon county, a well in the Lower Hudson 98 feet deep yielded in 1888,100 gallons of good lubricating oil per week. The oil is black, and has a gravity of 23.5° B.

The statistics of the production of petroleum in Kentucky in 1889 and 1890 are as follows:

Total production and value.

	1889.	1890.
Total production (barrels of 42 gallons)	5,400	6,000
Total value at wells of all oil produced, excluding pipage	$5,400	$6,000
Value per barrel	$1	$1

No stock is reported on hand December 31, 1888 and 1889.

Well record.

Total number of producing wells December 31, 1888	5
Total number of producing wells December 31, 1889	6
Number of pumping wells December 31, 1888	5
Number of pumping wells December 31, 1889	6
Number of wells completed in 1889	3
Number of dry holes in 1889	1
Number of producing wells completed in 1889	2
Initial daily production of new wells (barrels)	7
Value of materials used in caring for and operating wells in 1889	$3,050

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$25,000
Number of acres of oil land:		
Owned	100	
Leased	51,500	
Total acreage	51,600	
Present value of land, both owned and leased (actual expenditures on same for oil purposes)		10,150
Average value per acre, $0.20.		
Value of rigs, wells, engines, boilers, etc		9,000

Value of tanks	$750
Value of tank cars	1,800
Value of pipe lines at wells owned by parties making report	200
Value of other property and improvements	3,100
Total	14,850

Labor and wages.

All labor, not including office force:		
Number of foremen or overseers	2	
Total wages paid all workmen of this class in 1889		$1,248
Number of mechanics	8	
Total wages paid all workmen of this class in 1889		660
Number of laborers	4	
Total wages paid all workmen of this class in 1889		1,142
Total number of persons employed and wages paid in 1889	14	3,050
Wages paid for labor:		
In building rigs		$200
In drilling wells (part contract)		1,650
In operating and caring for wells		1,200
Total		3,050

Classified wages.

Class of labor.	Number of each class.	Range of wages.	Days employed.
Foremen	2	$52.50 to $70 per month	50 to 313
Pumpers or engineers	4	$24 to $30 per month	50 to 313
Rig builders	2	$1 per day	20
Drillers	4	60 cents per foot	40
Tool dressers	2	$1.75 per day	40
Laborers	2	90 cents to $1 per day	Various.

ILLINOIS.

The only oil produced in Illinois in 1889 was from some wells near Litchfield, in Montgomery county. The oil is a lubricating one, dark, almost black in color, and of 22° B. specific gravity. The cold test is remarkable, the oil remaining fluid at 20° below zero, Fahrenheit. It is largely used by the factories in the neighborhood of Litchfield, and is sold to consumers at near-by points for lubricating purposes, bringing from 8 to 10 cents per gallon in bulk, according to quantity. In all there have been thirty wells bored in the neighbood of Litchfield, chiefly for gas. The depth of these wells ranges from 640 to 670 feet. All save five were abandoned years ago. These five wells continue to produce the character of petroleum mentioned above. The average production of these wells is about 4 barrels a day. They are pumped by heads, and one man attends to them all. Natural gas from wells near by is used to some extent in furnishing fuel for pumping the wells. The supply of gas is about equal to 12 tons of coal a year, and 12 tons additional are used in pumping. The supply of natural gas is gradually diminishing.

The statistics of the production of petroleum in Illinois in 1889 are are as follows:

Total production and value.

Total production in 1889 (barrels of 42 gallons)	1,460
Total value at wells of all oil produced, excluding pipage	$4,906
Value per barrel	$3.36

Stocks of oil on hand at wells.

	Barrels.
December 31, 1888	110
December 31, 1889	100

Well record.

Total number of producing wells December 31, 1888	5
Total number of producing wells December 31, 1889	5
Total number of pumping wells December 31, 1888	5
Total number of pumping wells December 31, 1889	5
Value of materials used in pumping, operating, and caring for wells in 1889	$760

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$12,336
Number of acres of oil land:		
Owned	20	
Leased	5,000	
Total acreage	5,020	
Present value of land, both owned and leased		2,600
Average value per acre, $0.52.		
Value of rigs, wells, engines, boilers, etc		9,000
Value of tanks		250
Value of pipe lines at wells owned by parties making report		150
Value of oil in stock at wells December 31, 1889		336
Total		9,736

Labor and wages.

Total number of persons employed in 1889	1
Total wages paid all workmen	a $600

One engineer or pumper was employed 365 days, at $50 per month.

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[a] Paid for operating and caring for wells.

KANSAS.

The only section of Kansas in which oil has been found in what may be termed paying quantities, and even here the production is very small, is in Miami county, near Paola. In this county "tar" or oil springs have been known to exist from the earliest settlement of the State. One of these springs, some 8 miles east of the town of Paola, has led to the drilling of a number of wells in search of oil during the past thirty years. As early as 1858 leases were obtained and there was considerable talk of developing the oil field here. In 1861 a well was drilled 5 miles east of Paola, in which it is reported that oil was found, but the well filled with water, soon caved in, and no oil in commercial quantities was produced. Another well was started 2 miles east of Paola in the same year, but was abandoned before the oil rock was reached.

In a report made by Prof. Mudge, in 1864, he refers to the existence of oil and bitumen in the eastern tiers of counties of the State. In Prof. Swallow's report of 1865 he makes reference to 19 different tar springs within Miami county, and adds that "scarcely a well has been dug without finding petroleum in some of its forms." Prof. Swallow concludes that these facts are "very strong evidence of the existence of large reservoirs in these localities." Although large reservoirs of oil or gas may be found, as Prof. Swallow predicted, yet the facts which he presents in themselves are not necessarily sufficient to warrant such a conclusion. In 1865 a St. Louis company drilled 2 wells about 10 miles east of Paola. These wells were reported to have been drilled to a depth of 700 feet, when the tools were lost. In 1873 a company was organized, known as the Kansas Mining Company, and the same year drilled a well on the northeast quarter of section 16, township 19, range 24 (Westfall farm), near one of the largest of the "tar springs." At a depth of 320 feet a strong flow of gas was found and work stopped. Other gas wells were soon drilled on the same farm and gas was piped to Paola, a distance of 7 miles, by the Paola Gas Company. In 1888 one of the wells on the Westfall farm was drilled deeper, and it was found that under the gas rock there was an oil rock 12 to 16 feet thick, producing a very heavy black oil. This well bailed from 1 to 2 barrels per day. As the oil interfered with the gas, for which the well was drilled, it was plugged off at the bottom of the gas rock and the well turned again into the gas main. It was soon ascertained, however, that the oil was of such value as a lubricant that wells of 1 or 2 barrels per day could be worked at a profit, and the Paola Gas and Land Company purchased the property of the Paola Gas Company, and prospecting for oil began in the spring of 1889. The first well of recent years, drilled especially for oil, was put down in May, 1889, on the northwest quarter of section 16, township 17, range 24, and at a depth of 330 feet a good oil sand was struck, the gas sand lying at 316 and 328 feet and the oil sand at 330 to 341 feet. This well, known as No. 29, was shot with

10 quarts of nitroglycerin, and when cleaned out the gas shot a stream of oil to the top of the derrick. The well was tubed, the casing head packed, and the oil flowed by the gas. This well at first produced 15 barrels per day for 4 months.

In the fall of 1889 and spring of 1890, 4 wells were drilled by the same company 3 miles southwest of Paola, and the oil rock struck at about the same level as in the eastern field, but the rock was much harder and the oil much lighter. The west field has a much stronger head and promises a much larger yield than the east field.

There are at least three districts near Paola. The first is Russell tract, or Westfall farm, about 7 miles east of Paola and 2 miles from Somerset station, on the Missouri Pacific railroad; the others are nearer Paola, one being, as stated, 3 miles southwest, and the other just at the edge of the town. As above noted, gas was at first the object of the recent drilling near Paola. Well No. 1, in Russell tract, was bored for gas in 1882. Since that time 56 wells have been drilled by the Paola Oil, Gas and Mining Company and its predecessors. As stated above, it was not until 1888 that wells began to be drilled for oil. The Russell tract is now one of value as an oil producer, the pressure of the gas not being strong enough to force it through the 2½ inch pipe laid from Russell to Paola, a distance of 7 miles. Thirteen wells are now (1890) producing oil.

The structural geological conditions of Kansas when viewed by themselves are favorable to the existence of natural gas and oil. The rocks underlying Kansas are comparatively horizontal, the general dip being toward the west and northwest. The highest geological strata in eastern Kansas is the Carboniferous, while westwardly higher formations are found. Going from the northern toward the southern portion of the the State, within the Coal Measure area, the strata thicken, as the records of the oil and salt wells in Miami county seem to prove. The best oil well in this district, No. 39, drilled in May, 1889, has the following record:

Record of petroleum well in Miami county, Kansas.

	Feet.
Cased to	280
Soapstone	20
Sandy shale	11
White slate	3
Gas sand (very good)	10
White slate	4
Oil sand	13
Total	341

The sand in which the oil is found is stated to be "identical with Bradford in appearance." It certainly has that look of light-colored coarse maple sugar that is seen in the Bradford sand when filled with oil. The oil itself is a heavy, black, fatty substance of remarkable lubricating properties. A test taken by the writer on the afternoon of May 7, 1891, temperature 70° F., showed the gravity to be 23½° B., zero cold test, and 280° fire test. This refers to the oil in the Russell tract, or from the Westfall farm. That from the district 3 miles southwest of Paola is much lighter, having a gravity of 30°, zero cold test, 100° fire test, and not so densely black as the oil in the eastern field. The oil contains none of the lighter hydrocarbons; even at 300° F. nothing distilled over. A little water remains obstinately entangled in the oil, which at that temperature produces frothing to such a degree as to interrupt further distillation. Even in some cases the temperature of the retort has been carried to 400° F. without the production of a drop of distillate. As stated above, the quality of this oil as a lubricant is phenomenal. Without the least artificial preparation it has given some remarkable results as a lubricant under the most severe tests, especially on railroads running through the alkali country.

While the foregoing statements apply chiefly to the oil produced in Miami county, near Paola, oil has been found in other portions of the State apparently on the same general degree line as at Paola. These discoveries of oil have been made chiefly when boring for natural gas.

In Kansas City, Kansas, oil was struck when boring for natural gas, usually at a depth of from 300 to 400 feet. As natural gas was the product sought in drilling the wells, and as it was difficult to market the oil, which was produced in small quantities, at satisfactory prices, the wells were allowed to drown out in most cases when it was found that they did not produce sufficient natural gas to pay for operating them.

The record of a well bored in Kansas City is as follows:

Record of a well bored at Kansas City, Kansas, for natural gas in 1889.

[Feet.]

Strata.	Thickness of each stratum.	Total depth.	Strata.	Thickness of each stratum.	Total depth.
Loam and clay	14.0	14.0	Shale	25.0	180.0
Limestone	19.0	33.0	Limestone	15.0	195.0
Shale	30.0	63.0	Shale	18.0	213.0
Limestone	12.0	75.0	Limestone	10.0	223.0
Shale	5.0	80.0	Shale	170.0	393.0
Limestone	20.0	100.0	Limestone	5.0	398.0
Shale	5.0	105.0	Shale	38.0	436.0
Limestone	10.0	115.0	Limestone	4.0	440.0
Shale	30.0	145.0	Black shale	26.0	466.0
Flint	10.0	155.0	Sand rock	16.8	482.8

Oil was struck at a little over 400 feet; gas from 266 to 476 feet; hard, close sand from 476 to 480 feet; gas from 480 to 482.8 feet.

At Fort Scott, Kansas, oil was found in 2 or 3 wells when drilling for natural gas. Its character seemed to be the same as that of the Paola oil. As the quantity of gas was insufficient to pay for operating the wells they were abandoned. At Wyandotte and Coffeyville oil has been found under similar conditions to those existing at Paola, but no attempt has been made to save the same.

It has been extremely difficult to secure statistics of the production of oil in Kansas for 1889, as no record was kept. The best information received indicates that there were three wells producing oil December 31, 1889, at Paola, the production for that year being about 300 barrels, valued at $1,500. Nearly the entire amount of this oil remained on hand at the close of the year, little or no product having been sold. A small amount of oil, some 200 barrels, was also produced in Kansas City from wells drilled for gas. This was also lubricating oil of about the same quality as that produced in Paola. The statistics of the production of petroleum in Kansas in 1889 and 1890 are as follows:

Total production and value in 1889 and 1890.

	1889.	1890.
Total production (barrels of 42 gallons)	500	1,200
Total value at wells of all oil produced, excluding pipage	$2,500	$8,400
Value per barrel	$5	$7

Stocks of oil on hand at wells.

	Barrels.
December 31, 1888	100
December 31, 1889	100

Well record.

Total number of producing wells December 31, 1888	4
Total number of producing wells December 31, 1889	4
Total number of pumping wells December 31, 1888	4
Total number of pumping wells December 31, 1889	4
Number of rigs building December 31, 1889	2
Value of material used in pumping, caring for, and operating wells in 1889.	$500

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the businees		$75,000
Number of acres of oil land leased	4,000	
Present value of land		40,000
Average value per acre, $10.		
Value of rigs, wells, engines, boilers, etc.		25,000
Value of tanks		2,500
Value of pipe lines at wells owned by parties making report		3,000
Value of oil in stock at wells December 31, 1889		500
Value of other property and improvements		4,000
Total		35,000

Labor and wages.

All labor, not including office force:		
Number of mechanics	2	
Total wages paid all workmen of this class in 1889		$1,000
Number of laborers	6	
Total wages paid all workmen of this class in 1889		2,500
Office force:		
Total number (males)	2	
Total wages paid (males)		2,500
Total number of persons employed and wages paid in 1889	10	6,000

Wages paid for labor:	
In building rigs	$300
In operating and caring for wells	3,000
In building or repairing tankage	100
In building and repairing pipe lines	100
In office	2,500
Total	6,000

Classified wages.

Class of labor.	Number of each class.	Range of wages (per day).	Days employed.
Pumpers or engineers	1	$1.50	All.
Carpenters	1	2.50	200
Rig builders	1	2.50	100
Drillers	2	3.50	250
Tool dressers	2	2.00	250
Laborers	2	1.25	300

TEXAS.

Similar conditions to those found in Kansas, New Mexico, and the southern part of California exist in Texas. Springs, known locally as tar springs, are found scattered over various portions of the State, especially in the northeast, southeast, and central portions. The oil wells of Kansas and Missouri are found a little east of the ninety-fifth meridian of longitude west of Greenwich. The Texas springs are a little to the east of the ninety-fourth meridian, and some are also found on the ninety-third and east of it. The petroleum produced in Texas in 1889 was in Bexar county, near San Antonio, about midway between the ninety-eighth and ninety-ninth meridians. The product of these springs is known locally as petroleum, and is in this report so classified, though some geologists, especially those who have been connected with the geological survey of California, insist on calling it maltha. At present, however, they acknowledge that this so-called maltha and petroleum are similar substances. Chemically they may be; practically they are not.

The Texas oil is a natural lubricator of from 28° to 30° gravity, and is said to be found in a conglomerate. The wells are shallow, the oil being struck in various parts of the State at from 125 to 350 feet. The Bexar county wells, which produced the petroleum reported upon from this State in 1889, are about 300 feet deep. As there is but a limited demand for the oil, there is no effort to produce it in large quantities. The 2 wells producing in 1889, which were on the ranch of Mr. George Dulnig, were wells that had been drilled originally for procuring water. They were found to yield small quantities of oil and gas. The production of these 2 wells in 1889 was about 4 barrels a month.

Outside of the oil produced in Bexar county none seems to have been produced in the State on a commercial scale, though reports as to the discovery of oil at various points in Texas are frequent. At Sulphur Springs, in Hopkins county, there are certain so-called "sour wells," which produced a few gallons of oil. In 1887 and 1888 considerable excitement was occasioned by the reported striking of oil in Nacogdoches county. The locality was some 80 miles southwest of Shreveport. The wells were driven wells, and some oil was obtained at the depth of 85 feet; in other cases at a depth of 300 feet. Quite a number of wells were driven in 1887 and 1888, but no petroleum was produced in 1889. The oil produced in Bexar county was used for lubrication. It retailed in barrels at 20 cents a gallon, in tin cans of 5 gallons at 30 cents, and in smaller quantities than 5 gallons at 35 cents a gallon.

The statistics of the production of petroleum in Texas in 1889 and 1890 are as follows:

Total production and value in 1889 and 1890.

	1889.	1890.
Total production (barrels of 42 gallons)	48	54
Total value at wells of all oil produced, excluding pipage	$340.00	$227.00
Value per barrel	7.08⅓	4.20

Stocks of oil on hand at wells.

	Barrels.
December 31, 1888	6
December 31, 1889	48

Well record.

Total number of producing wells December 31, 1888	2
Total number of producing wells December 31, 1889	2
Total number of pumping wells December 31, 1888	2
Total number of pumping wells December 31, 1889	2

Capital.

Total capital invested in wells, (a) leases, etc., and employed in the business	$1,650
Value of rigs, wells, engines, boilers, etc	1,200
Value of tanks	100
Value of pipe lines at wells owned by party making report	10
Value of oil in stock at wells December 31, 1889	340
Total	1,650

The work is all done by ranch hands; no special men are employed, the production of the wells being but 4 barrels per month.

MISSOURI.

The only oil produced in Missouri in 1889 and 1890 concerning which it has been possible to secure any information was in West Boone township, Bates county, near the Kansas State line, southwest from Paola, where the oil produced in Kansas in 1889 was found. This oil was all produced from 1 well, drilled in 1886 for water. The oil comes from sand 220 feet in depth. It is similar in every respect to the Kansas oil. The well is pumped by a windmill and yields less than 1 barrel a day. The oil is sold to local trade for lubricating purposes. In 1889, 20 barrels of oil, valued at $40, were produced. All oil is sold as soon as produced. The cost of operating the well in 1889 was $350; the total capital, $750. The territory consists of 600 acres of land, valued, as oil territory, at $210, the rigs, wells, engines, etc., being valued at $520 and tank at $20. There was but 1 producing well and 1 tank. The cost of drilling the well was $1.50 a foot.

There is an interesting history connected with the drilling of some wells at Adrian, Bates county, Missouri. Oil was discovered here in 1889 at a depth of 33 feet while prospecting for coal. The oil sand was some 25 feet thick, overlaid with soapstone shale to a thickness of 8 feet. The oil oozed from the rock into the shaft and was bailed out. The shaft was in the creek bottom, and being flooded by the first high water the well ceased to produce. A number of drill holes were then put down. Three of these produced about 6 gallons in ten hours, but the holes were not cased, and they were soon drained out by water. In 1883 a derrick was erected, proper oil tools procured, and a well sunk over 500 feet. All the oil secured in this well was found at from 33 to 90 feet in depth. The well was pumped but once, and then only for ten hours, the product being 20 gallons of oil, with a large quantity of water. The oil is similar in character to that found at Paola.

Mr. R. B. Marshall, of Adrian, states that he has done a great deal of prospecting for oil in that section of the country, and finds a strip

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[a] These wells are sunk on the ranch of the owner, and no value is placed on the land as oil territory.

of territory some 10 miles long and from 1 to 3 miles wide underlaid with gas and oil, but that the difficulty with the region as a producing territory is that the sand is too fine and the oil too thick to give any great production. There is a great deal of sand rock impregnated with oil which can be driven out by heat. The statistics of the production of petroleum in Missouri in 1889 and 1890 are as follows:

Total production and value in 1889 and 1890.

	1889.	1890.
Total production (barrels of 42 gallons)	20	278
Total value at wells of all oil produced, excluding pipage	$40	$556
Value per barrel	$2	$2

No stock was reported on hand at the wells December 31, 1888 and 1889.

Well record.

Total number of producing wells December 31, 1888	1
Total number of producing wells December 31, 1889	1
Total number of pumping wells December 31, 1888	1
Total number of pumping wells December 31, 1889	1
Value of materials used in pumping, operating, and caring for wells in 1889	$5

Capital.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business	$750
Number of acres of oil land owned	600
Present value of land as oil territory	$210
Average value per acre, $0.35.	
Value of rigs, wells, engines, boilers, etc	$520
Value of tanks	20
Total	540

Labor and wages.

Total number of persons employed in 1889	1
Total wages paid all workmen	(*a*) $350

TENNESSEE.

At a point about 8 miles north of White Bluff, in Dickson county, Tennessee, on Jones creek, oil has been known to exist since 1865. It is said seven wells have been drilled at this place by different parties some of them being shallow and the deepest well being upwards of 2,000 feet deep. There was but one actually dry hole, and that was abandoned at 640 feet. The shallow wells produced oil in small quantities at a depth of 187 feet. Two wells have been cased and have

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[a] Paid for operating and caring for wells.

small quantities of oil in them, but since there is no market for crude oil in this State or immediate vicinity, wells have been neglected and no attention paid to its development. The product is not utilized except to a small extent for lubricating purposes. It is firmly maintained by residents there that oil can be found in remunerative quantities.

Oil is generally found at an average depth of 150 feet, in a sandstone of 20 feet in thickness. Gas and salt water are also found.

ALABAMA.

Though no oil was produced in Alabama during the census year, still, in view of the fact that drilling was recommenced in 1890, some account is given of the history of oil production in this State and the prospects of future production.

In various parts of northern Alabama there are found springs which yield natural gas and petroleum to a limited extent, though as yet these products have not been found in sufficient quantities to be of any commercial value. There are also found in the same section in the outcroppings of the Carboniferous formations "tar" springs somewhat similar to those of California, from which there exudes a thin bitumen, known as "maltha." Shortly after the beginning of the petroleum excitement in Pennsylvania in 1859 many wells were drilled at points indicated by these natural gas and petroleum and tar springs. Some oil was found, but not in sufficient quantities to justify the continuance of operations.

The best known of the Alabama tar springs are just outside of Moulton valley. These springs are in the outcroppings of a very highly fossiliferous, coarse-grained, siliceous limestone that has a cover of reddish and greenish argillaceous shales. Near the lower of the two springs is a well said to have been drilled for oil some years ago to a depth of 106 to 107 feet. The Goyer Oil Company, of Memphis, Tennessee, proposes to put down wells near these springs. At present (June, 1891), two wells have been completed, in one of which a dark-green oil was found at a depth of 1,509 feet. The first oil secured in small quantities was at the top of the Trenton limestone, at a depth of 1,355 feet. This well was computed by Dr. McRae to be a 25-barrel well. The second oil sand, from which most of the oil came, is believed by Mr. Henry McCalley to be some 300 feet down in the Trenton limestone, or some 200 feet lower geologically than any known productive oil sand in this country.

Oil wells are to be drilled in other parts of the State.

WYOMING.

Though oil has been known to exist in Wyoming for more than thirty years and though developments made in 1885 and since point to the presence of valuable oil deposits in this region, the oil industry has assumed, as yet, no importance, owing chiefly to the distance of the producing territory from any important market and the expense of transportation thereto. The developments of importance have been confined chiefly to two districts, one known as the "George B. Graff Oil-Mining district," in the county of Fremont, in the western part of the State, not far from Dallas, and at the base of the Wind River mountain, and the other known as the "Stockdale Oil-Mining district," in Weston county, in the extreme northeastern part of the State, near the Black Hills and New Castle. The first district, the "George B. Graff," is named for the late Dr. George B. Graff, of Omaha, who developed the property. The amount of oil in this district is indicated from the fact that there are about 50 open oil springs in Fremont county, 14 within a radius of 20 miles of Lander. In 1885 four wells were sunk to the upper oil-bearing sands. The depth of these wells and their product as given at that time are as follows:

Depth and flow of Wyoming oil wells.

Wells.	Depth.	Flow per day.
	Feet.	*Barrels.*
No. 1	85	85
No 2	100	100
No. 3	350	325
No. 4	1,200	825
Total	....	1,335

It is probable the production of some of these wells as given is too great. Several statements received from this district are to the effect that three of the wells which were drilled about this time were shut in or "packed" with Hodley packers; that if they were allowed to flow, or (to use the local expression) "let loose," they would produce some 200 barrels per day per well; and that in the neighborhood of these wells a lake, 300 yards long by 30 yards wide, was made to receive their overflow, and it is estimated that in this lake there are now some 15,000 barrels that were produced as long ago as 1886. Nothing has been done in the way of development or production in this district since this date. Regarding this oil field, Mr. L. D. Ricketts, Territorial geologist, states: "These wells are cased and supplied with valves to prevent the oil from escaping, but, owing to the great gas pressure, a leakage can not be prevented. The pressure is so great that upon suddenly opening the valves the oil spurts up 75 feet into the air, like some black-watered geyser. After the pipe thus clears itself the steady flow of oil is resumed, which, as variously estimated, will aggregate from 600 to 1,000 barrels per 24 hours." The oil is found in two strata, the upper a "black sand," averaging about 70 feet in thickness, and the other is a "black pebble" or "dark conglomerate," varying in thickness, according to different authorities, from 400 to 800 feet. The oil in this district is low in illuminants, averaging about 25 per cent. It is proposed, and a company has been organized for the purpose, to pipe the oil to Denver, 250 miles distant, and to sell it for fuel.

Regarding the second district, the "Stockade Oil-Mining district," which is located in the Black Hills, near New Castle, in Weston county, but little information has been obtained. A large quantity of Government land, supposed to contain oil, has been located in this district. A list of some 376 locations of 160 acres each, amounting to 60,160 acres, has been furnished the census special agent. This land, at the Government price of $2.50 an acre, would be valued at $150,400. In order to hold these leases $200 worth of improvements must be put upon the land. If all of the claims were finally taken up this would add $75,200 to the value of the land entered as oil land in this district. It is known, however, that in many cases the claims have been abandoned. So far as has been learned, no amount of oil has ever been produced in this district, though indications are very favorable to the securing of a large supply.

NEW MEXICO.

Information has been received of a very small production of a heavy lubricating oil in Bernalillo county, on section 11, township 16 north, range 16 west. This oil flows naturally from the rocks containing it. The product is stated to be a barrel a day, which is probably in excess of the actual production. It is sold in small quantities to consumers in the immediate vicinity at the rate of $10 a barrel. The larger proportion of the production is wasted and lost. It is also reported that there are several places on the Navajo Indian reservation where petroleum exudes in a similar manner from the crevices in bituminous sandstone, and there is no doubt that at many places in New Mexico the same phenomena that are noticed in Colorado and Wyoming will be found to exist.

NATURAL GAS.

BY JOSEPH D. WEEKS.

Previous to the investigation into the production of natural gas by the Eleventh Census no attempt had been made to determine the volume of this fuel produced or consumed. The want of meters to measure the gas, the methods of use, and the profligate waste which characterized the early utilization of what is now known to be a valuable product, rendered even an approximate estimate of the amount utilized impossible. This waste has been checked, more economic methods have been adopted, and meters have been invented that give approximately correct measurements. That the supply of gas is limited and will ultimately be exhausted has never been questioned. There is no accurate method of estimating how great a store of this product we have to draw upon, and even when we are able approximately to determine how much is being consumed, it is impossible to say how long it will last at the same rate of consumption. During 1889, according to the census report, the total consumption of natural gas in the United States was 552,150,000,000 cubic feet. This figure is of course but an estimate, but must be taken as the best approximation possible. The distribution of this consumption by industries is ascertained to be about as follows:

Total consumption of natural gas in the United States in 1889.

	Cubic feet.
Iron and steel mills	171,500,000,000
Glass works	18,750,000,000
Other industrial establishments	236,900,000,000
Heating and cooking	62,500,000,000
Pumping oil	7,500,000,000
Drilling and operating oil and gas wells	30,000,000,000
Other uses	25,000,000,000
Total	552,150,000,000

Value.—It has been found, in the preparation of previous volumes of Mineral Resources, that the best mode of arriving at the value of natural gas consumed is by estimating the value of coal displaced by its use. In 1889 the value of the gas consumed as actually returned is given at $11,044,858. The value of fuel displacement, which is regarded as the actual value, was $21,097,099. This includes 69,018 cords of wood displaced in Ohio and Indiana, valued at $165,040. The amount of coal displaced in the United States is placed at 10,198,930 tons, with a value of $20,732,059. In 1890 the value of the displacement is given as $18,667,725.

The following table, from Mineral Resources of the United States, 1888, gives the amount and value of coal displaced by natural gas from 1885 to 1888, inclusive, by principal gas-producing districts:

Amount and value of coal displaced by natural gas from 1885 to 1888.

Localities.	1885.		1886.	
	Coal displaced.	Value.	Coal displaced.	Value.
Pennsylvania:-	*Short tons.*		*Short tons.*	
Allegheny county	2,000,000	$2,500,000	4,000,000	$5,000,000
Remainder of Pittsburg district	500,000	750,000	1,000,000	1,500,000
Western Pennsylvania, outside of Pittsburg district	500,000	1,250,000	1,000,000	2,500,000
New York	56,000	196,000	60,000	210,000
Ohio	50,000	100,000	200,000	400,000
West Virginia	20,000	40,000	30,000	60,000
Indiana	....	....	150,000	300,000
Illinois	600	1,200	2,000	4,000
Kansas	....	....	2,000	6,000
Michigan	....	....	4,000	12,000
Elsewhere	5,000	20,000	5,000	20,000
Total	3,131,600	4,857,200	6,453,000	10,012,000

Localities.	1887.		1888.	
	Coal displaced.	Value.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*		*Short tons.*	
Allegheny county	5,477,000	$6,846,250	7,302,700	$10,223,780
Remainder of Pittsburg district	1,610,500	2,415,750	2,447,330	3,670,995
Western Pennsylvania, outside of Pittsburg district	1,795,500	4,487,500	2,693,800	5,387,600
Total Pennsylvania	8,888,000	13,749,500	12,443,830	19,282,375
New York	111,000	333,000	125,000	332,500
Ohio	500,000	1,000,000	750,000	1,500,000
West Virginia	60,000	120,000	60,000	120,000
Indiana	300,000	600,000	660,000	1,320,000
Elsewhere	5,000	15,000	25,000	75,000
Total	9,859,000	15,817,500	14,063,830	22,629,875

In the following tables are shown the amount and value of fuel displacement in 1889 and 1890, by States. In the statement for the former year is also shown the actual amount received by the companies for the gas consumed. The amount and value of the coal displaced by gas in 1890 was less than in 1889, but owing to the higher prices the amount actually received was probably fully $1,250,000 more than in 1889.

Value of natural gas consumed in the United States in 1889, by States, and the amount and value of coal and wood displaced by the same.

States and Territories.	Value of natural gas supplied and used.	Coal displaced.		Wood displaced.	
		Tons.	Value.	Cords.	Value.
Pennsylvania	$8,287,383	6,863,062	$11,593,989	....	....
Indiana	1,362,472	716,461	2,002,762	44,888	$72,940
Ohio	1,120,997	1,660,456	5,123,569	24,130	92,100
New York	204,325	130,159	530,026	....	....
Missouri	27,825	11,859	35,687	....	....
Kansas	13,660	4,538	15,873	....	....
California	12,680	3,517	12,680	....	....
Illinois	8,658	7,245	10,615	....	....
Kentucky	2,580	615	2,580	....	....
West Virginia	2,000	600	2,000	....	....
Texas	1,728	288	1,728	....	....
Arkansas	375	107	375	....	....
Utah	150	18	150	....	....
South Dakota	25	5	25	....	....
Total	11,044,858	9,398,930	19,332,059	69,018	165,040
Used at pipe lines	....	100,000	200,000	....	....
Used for drilling and pumping wells	....	400,000	800,000	....	....
Other uses	....	300,000	600,000	....	....
Grand total	11,044,858	10,198,930	$20,932,059	69,018	165,040

Amount and value of coal and wood displaced by natural gas consumed in the United States in 1890, by States.

States and Territories.	Coal displaced.		Wood displaced.	
	Tons.	Value.	Cords.	Value.
Pennsylvania	6,334,017	$9,551,025	....	....
Indiana	897,000	2,242,500	30,000	$60,000
Ohio	1,573,100	4,619,300	20,000	65,000
New York	138,000	552,000	....	....
Missouri	3,000	10,500	....	....
Kansas	6,000	12,000	....	....
California	5,500	33,000	....	....
Illinois	4,000	6,000	....	....
Kentucky	10,000	30,000		
West Virginia	1,800	5,400		
Texas Arkansas Utah South Dakota	2,000	6,000	....	....
Total	8,974,417	17,067,725	50,000	125,000
Used at pipe lines	100,000	200,000	....	....
Used for drilling and pumping wells	400,000	800,000	....	....
Other uses	300,000	600,000	....	....
Grand total	9,774,417	18,667,725	50,000	125,000

Pipe lines.—The total number of feet of pipe line used in the distribution of natural gas in the United States at the close of 1888 was 25,564,594, and at the close of 1889 was 37,746,093, divided into sizes as follows:

Total number of feet of pipe line used in the distribution of natural gas in the United States at the close of 1888 and 1889.

Sizes (inches).	1888.	1889.	Sizes (inches).	1888.	1889.
⅜	2, 201	3, 341	6	3, 308, 077	3, 866, 192
½	907	7, 135	8	5, 167, 462	6, 979, 459
¾	423, 764	886, 925	9 10	1, 405, 120	2, 141, 368
1	1, 157, 774	3, 039, 912			
1¼	324, 938	730, 454	12	642, 900	1, 369, 613
1½	632, 774	840, 226	14	643	643
2	4, 987, 328	7, 222, 308	16	369, 252	480, 693
2½	52, 360	53, 780	20	193, 780	205, 942
3	3, 052, 615	4, 213, 230	24	106, 669	148, 056
3¼ 3½	8, 422	8, 422	30 36	83, 091	92, 971
4	3, 165, 590	4, 913, 883			
5	294, 127	308, 434	Total	25, 564, 594	37, 746, 093
5⅝	184, 800	233, 106			

The tendency is toward the use of larger pipes, as these will transport more gas with less loss by friction than smaller pipes.

The following statements taken from the report of the Eleventh Census show very clearly the capital, wages, and other expenditures required for supplying the natural gas.

CAPITAL.

The total capital reported as invested in the production and transportation of natural gas in the United States at the close of 1889 was $59, 682, 154. Of this amount $12,795,715 is given as the value of lands and $46,886,439 as the value of rigs, wells, pipe lines, and other property.

The total acreage of land, both owned and leased, held by natural gas producers, is reported at 564,700. Of this amount 46,802 acres are reported as owned and 517,898 acres leased. The average value per acre of this land is $22.66. This is evidently too low a valuation, and probably comes from the fact that it is based on the amount paid for leases. This question has been so thoroughly discussed on the report on the production of petroleum that it need only be referred to here. It is customary in leasing oil or gas land to pay so much bonus down for the lease, the amount varying from $5 to $50 an acre, and a royalty of the gas produced. It is fair to assume (certainly it is fair in consideration of the fact that $20,000,000 worth of gas was produced from these 564,700 acres of land) that the average value of this land is at least $100 an acre.

Of the 564,700 acres of land held in the United States 467,175 acres were held in Pennsylvania, Indiana and Ohio. This amount is certainly worth an average of more than $100 an acre, some of it considerably more. Assuming this price, $100, for the average value of all land held, the value of land would be $56,470,000, instead of $12,795,715. It is but fair to say that some of this land reported as gas land is also oil land, certain wells on the same leases producing oil and others gas.

Of the $46,886,439 reported as the value of property other than lands,

$7,472,157 is given as the value of rigs, wells, etc., $31,637,284 as the value of pipe lines used in transporting the gas from wells to consumers, and $7,776,998 as the value of other property.

Capital invested in the natural gas industry in the United States in 1889.

States and Territories.	Number of acres of natural gas land.				Value of plant.			Total capital.
	Total acreage.	Owned.	Leased.	Value.	Rigs, wells, etc.	Pipe lines.	Other property.	
Pennsylvania	277,430	25,411	252,019	$7,589,968	$3,757,961	$18,955,018	$4,095,885	$34,398,832
Indiana	77,493	12,294	65,199	1,090,218	1,396,949	4,792,548	926,098	8,205,813
Ohio	112,252	3,712	108,540	3,241,679	1,702,051	6,418,342	1,591,678	12,953,750
New York	49,870	533	49,337	298,120	169,753	580,519	114,037	1,162,429
Missouri	15	5	10	176,800	90,800	44,200	1,500	313,300
Kansas	2,002	2	2,000	10,200	22,500	27,200	100,100	160,000
California	6	6	....	1,900	49,635	215	....	51,750
Illinois	19,044	44	19,000	3,200	23,620	18,400	....	45,220
Kentucky	23,215	3,800	19,415	275,550	128,950	800,700	941,200	2,146,400
West Virginia	218	....	218	11,280	103,395	25	....	114,700
Texas	725	725	....	72,500	1,500	....	6,000	80,000
Arkansas	2,000	....	2,000	20,000	3,500	....	500	24,000
Utah	....	....	....	....	2,970	30	....	3,000
South Dakota	....	....	....	....	1,273	87	....	1,360
New Mexico	....	....	....	....	3,000	....	....	3,000
Tennessee	270	270	....	2,700	11,800	....	....	14,500
Wisconsin	160	....	160	1,600	2,500	....	....	4,100
Total	564,700	46,802	517,898	12,795,715	7,472,157	31,637,284	7,776,998	59,682,154

Labor and wages in producing natural gas in 1889.—The total number of persons employed in the production of natural gas in the United States in 1889 is given as 6,684, to whom $1,736,389 was paid in wages. Of the total number of employés, 374 were foremen or overseers, 889 mechanics, 5,004 laborers, 6 boys under 16 years, 395 males engaged in office work, and 16 females engaged in office work. It must be understood that these workmen were employed not only in the production of gas, but in its distribution. This report is by no means satisfactory and is to a large extent meaningless, or at least the terms used are such as to lead to confusion in the classification. A better classification is given in the second table below, which shows more in detail the number of persons employed and by more definite occupations.

Labor and wages in producing natural gas.

States and Territories.	Foremen or overseers.		Mechanics.		Laborers.	
	Number.	Wages.	Number.	Wages.	Number.	Wages.
Pennsylvania	145	$126,424	399	$207,210	2,529	$571,445
Indiana	153	58,865	324	97,091	1,408	134,388
Ohio	59	40,702	97	32,997	757	125,938
New York	11	4,152	37	4,443	206	17,687
Missouri	....	....	1	50	1	35
Kansas	....	....	1	900	1	200
Illinois	1	750	....	....	3	172
Kentucky	3	3,360	14	8,056	3	520
West Virginia	....	....	6	1,800	....	....
Texas	1	900	1	720	1	360
Arkansas	....	....	4	2,500	....	....
South Dakota	....	....	1	73	....	....
New Mexico	....	....	4	2,000	....	....
Wisconsin	1	400	....	....	5	1,200
Total	374	235,553	889	357,840	5,004	851,945

Labor and wages in producing natural gas—Continued.

States and Territories.	Boys under 16 years.		Office.				Total.	
			Males.		Females.			
	Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.
Pennsylvania	1	$50	202	$185,567	6	$2,013	3,282	$1,092,700
Indiana	2	160	115	49,287	5	2,060	2,007	341,851
Ohio	3	438	63	40,337	4	806	983	241,218
New York			12	7,868	1	85	357	34,235
Missouri							2	85
Kansas			1	1,000			3	2,100
Illinois			1	300			5	1,222
Kentucky			1	1,080			21	13,016
West Virginia							6	1,800
Texas							3	1,980
Arkansas							4	2,500
South Dakota							1	73
New Mexico							4	2,000
Wisconsin							6	1,600
Total	6	648	395	285,439	16	4,964	6,684	1,736,389

Of the $1,736,389 paid for wages in 1889, $235,553 was paid to foremen or overseers, $357,840 to mechanics, $851,945 to laborers, $648 to boys under 16 years, $285,439 to office force, males, and $4,964 to office force, females. In addition to these wages a large amount of money was paid to contractors for drilling wells, laying pipe lines, etc., into which labor entered largely. Of wages so paid no account is given.

In the following table will be found totals showing the occupation and number of employés of each kind in the United States:

Number and occupations of employés about gas wells in 1889.

Class of labor.	Pennsylvania.	Indiana.	Ohio.	New York.	Missouri.	Kansas.	Illinois.	Kentucky.	West Virginia.	Texas.	Arkansas.	South Dakota.	New Mexico.	Wisconsin.	Total.
Presidents	1														1
Treasurers	1	1													2
Bookkeepers	36	80	9	7											132
Clerks, males	160	41	40	4		1	1	1							248
Clerks, females	4		17	1											22
Telegraph operators	6		1	3											10
Superintendents	13	29	7	5											54
Foremen or overseers	130	121	44	10			1	3		1				1	311
Electricians	1		8												9
Inspectors	34	5													39
Station agents	25	10													35
Agents				1											1
Engineers	2	6		2											10
Fitters or plumbers	146	160	12												318
Drillers	61	38	32	10		1			4						146
Tool-dressers	22		12												34
Carpenters	21	5							2						28
Fieldmen or wellmen	52		6	3											61
Teamsters	19	10		13											42
Linemen	23	33		3											59
Warehousemen	2														2
Blacksmiths	2														2
Tongsmen	69														69
Watchmen	7			5											12
Mechanics	153	92	37	33	1			14		1	4	1	4		340
Laborers	2,291	1,374	755	257	1	1	3	3		1				5	4,691
Boys under 16 years	1	2	3												6
Total	3,282	2,007	983	357	2	3	5	21	6	3	4	1	4	6	6,684

Total expenditure for materials during 1889.—The total expenditure during 1889 for all materials used in drilling wells, operating and caring for the same, building pipe lines, and for all other materials, was $13,184,497. Of this amount $165,677 was paid for materials used in building rigs, $467,540 for materials used in drilling wells, $282,882 for materials used in operating, shutting in, and caring for wells, $7,044,438 for pipe lines, $285,180 for materials used in fitting, $28,794 for torpedoes, and $4,915,086 for all other materials. Considerable work was done by contract, including labor and materials. It was impossible to make a division of the amounts between labor, materials, etc.

Total expenditures for materials during 1889.

States.	Building rigs.	Drilling wells.	Operating, shutting in, and caring for wells.	Pipe, couplings, etc., in building and repairing pipe lines.	Used in fitting.	Torpedoes.		All other materials.	Total.
						Number.	Value.		
Pennsylvania	$113,022	$326,674	$188,550	$855,192	$227,926	55	$6,167	$3,246,249	$4,963,780
Indiana	3,800	42,710	38,712	1,761,203	40,190	82	10,275	24,182	1,921,072
Ohio	26,019	66,751	44,710	4,261,054	970	86	8,228	1,315,133	5,722,865
New York ...	17,336	22,405	5,810	131,144	16,094	41	2,330	316,022	511,141
Missouri	500	....	....	12,200	....	....	....	1,500	14,200
Kansas.......	4,500	6,500	1,800	1,555	....	2	350	....	14,705
California....	....	....	....	90	....	....	....	....	90
Illinois.......	....	....	1,600	16,000	....	....	....	....	17,600
Kentucky....	500	....	1,700	6,000	....	15	1,444	6,000	15,644
Wisconsin ...	....	(*a*) 2,500	....	....	....	....	....	900	3,400
Total ...	165,677	467,540	282,882	7,044,438	285,180	281	28,794	4,915,086	13,184,497

a Includes cost of rigs, drive pipes, casing, and tubing.

STONE.

BY WILLIAM C. DAY.

The present report on stone in the United States is intended particularly to show the distribution by counties of the different varieties in the various productive States and Territories. With this purpose in view, each productive State and Territory is treated of by itself. The statistical figures apply in the large majority of cases to the calendar year 1889, and they serve to show the relative magnitudes of the industries. In addition to the subject of distribution, other features of interest in regard to the properties, the chemical constitution and physical structure of the stone and the purposes to which it is applied are included in so far as the data at hand at this time will permit.

In 1889 there were produced in the United States limestone, granite, sandstone, marble, slate, and bluestone, named in the order of their commercial importance.

The total value of this stone product, according to the results of the Eleventh Census, was $53,035,620, distributed as follows: Limestone, $19,095,179; granite, $14,464,095; sandstone, $10,816,057; marble, $3,488,170; slate, $3,482,513; and bluestone, $1,689,606. In 1890 no such detailed canvass of the United States was attempted as was executed in the previous year for the Eleventh Census. Building was more active in 1890 than in 1889, and the total shows fully the normal growth to a total value for stone of all kinds of $54,000,000.

LIMESTONE.

Production.—The value of the limestone produced in the United States in 1889, as shown above, was $19,095,179. It was produced in 40 States and Territories as follows:

Production of limestone in the United States in 1889, by States and Territories.

Rank.	States and Territories.	Value.	Rank.	States and Territories.	Value.
1	Pennsylvania	$2,655,477	22	Connecticut	$131,697
2	Illinois	2,190,607	23	New Jersey	129,662
3	Indiana	1,889,336	24	Massachusetts	119,978
4	Missouri	1,859,960	25	West Virginia	93,856
5	New York	1,708,830	26	Michigan	85,952
6	Maine	1,523,499	27	Tennessee	73,028
7	Ohio	1,514,934	28	Idaho	28,545
8	Wisconsin	813,963	29	Rhode Island	27,625
9	Minnesota	613,247	30	Utah	27,568
10	Iowa	530,863	31	Montana	24,964
11	California	516,780	32	Arkansas	18,360
12	Kansas	478,822	33	South Carolina	14,520
13	Alabama	324,814	34	New Mexico	3,862
14	Kentucky	303,314	35	Oregon	77,935
15	Washington	231,287	36	Georgia	
16	Texas	217,835	37	Florida	
17	Nebraska	207,019	38	Arizona	
18	Vermont	195,066	39	South Dakota	
19	Maryland	164,860	40	Wyoming	
20	Virginia	159,023			
21	Colorado	138,091		Total	19,095,179

Uses.—The principal purpose for which the limestone was used was for the production of lime, the value of the lime produced being $8,217,015. For building purposes $5,405,671 worth was used; for street work, $2,383,456; for a flux in blast furnaces the limestone used was worth $1,569,312; for bridge, dam, and railroad work, $1,289,622, and for miscellaneous purposes $230,103 worth was used.

GRANITE.

Production.—The value of the granite produced in the United States in 1889 was, as shown in the following statement, $14,464,095. This product was distributed among twenty-eight States and Territories, as follows:

Production of granite in the United States in 1889, by States and Territories.

Rank.	States.	Value of output.	Rank.	States.	Value of output.
1	Massachusetts	$2,503,503	16	South Dakota	$304,673
2	Maine	2,225,839	17	Wisconsin	266,095
3	California	1,329,018	18	New York	222,773
4	Connecticut	1,061,202	19	Delaware	211,194
5	Rhode Island	931,216	20	North Carolina	146,627
6	Georgia	752,481	21	South Carolina	47,614
7	New Hampshire	727,531	22	Oregon	44,150
8	Pennsylvania	623,252	23	Texas	22,550
9	Vermont	581,870	24	Utah	8,700
10	Missouri	500,642	25	Montana	76,000
11	Maryland	447,489	26	Arkansas	
12	New Jersey	425,673	27	Washington	
13	Minnesota	356,782	28	Nevada	
14	Virginia	332,548			
15	Colorado	314,673		Total	14,464,095

Uses.—The purposes to which the granite product was put were as follows: Building, $6,166,034; street work, $4,456,891; cemetery, monumental, and decorative purposes, $2,371,911; bridge, dam, and railroad work, $1,238,401, and miscellaneous uses, including millstones, walls (fences) watering troughs, posts, engine and machine beds, yard stock, boundary stone, horse blocks, etc., $230,858.

SANDSTONE.

Production.—The total value of the sandstone produced in the United States in 1889 was $10,816,057. The States contributing to this total were, in the order of output, as follows:

Production of sandstone in the United States in 1889, by States and Territories.

Rank.	States and Territories.	Value of output.	Rank.	States and Territories.	Value of output.
1	Ohio	$3,046,656	22	Alabama	$43,965
2	Pennsylvania	1,609,159	23	Montana	31,648
3	Colorado	1,224,098	24	Arkansas	25,074
4	Connecticut	920,061	25	Illinois	17,896
5	New York	702,419	26	Wyoming	16,760
6	Massachusetts	649,097	27	Texas	14,651
7	New Jersey	597,309	28	North Carolina	12,000
8	Michigan	246,570	29	Virginia	11,500
9	New Mexico	186,804	30	Maryland	10,605
10	Wisconsin	183,958	31	Arizona	9,146
11	California	175,598	32	Oregon	8,424
12	Missouri	155,557	33	New Hampshire	3,750
13	Kansas	149,289	34	Tennessee	2,722
14	West Virginia	140,687	35	Idaho	2,490
15	Minnesota	131,979	36	Rhode Island	26,199
16	Kentucky	117,940	37	Nevada	
17	South Dakota	93,570	38	Vermont	
18	Iowa	80,251	39	Florida	
19	Washington	75,936	40	Georgia	
20	Utah	48,306			
21	Indiana	43,983		Total	10,816,057

Uses.—The principal use to which the sandstone product of 1889 was put was for building, $7,121,942 worth, or over 65 per cent of the product being devoted to this purpose; for street work, a quantity valued at $1,832,822 was used, while bridge, dam, and railroad work consumed $1,021,920 worth of the product. For abrasive purposes $580,229 worth was used, and for miscellaneous uses, $259,144. The last classification includes the stone used for grout, hitching-posts, fence walls, sand for glass, sand for plaster and cement, furnace hearths, lining for blast furnaces, rolling-mill furnaces, adamantine plaster, millstones, cemetery work, watering troughs, fluxing, ganister, firebrick, silica brick, lining for steel converters, glass furnaces, core sand for foundries, and random stock.

MARBLE.

Production.—The value of the marble produced in the United States in 1889 was $3,488,170. This was the product of ten States, as follows:

Production of marble in the United States in 1889, by States.

Rank.	States.	Value of output.	Rank.	States.	Value of output.
1	Vermont	$2,169,560	7	Pennsylvania	$121,850
2	Tennessee	419,467	8	Massachusetts	
3	New York	354,197	9	Idaho	
4	Georgia	196,250	10	Virginia	
5	Maryland	139,816			
6	California	87,030		Total	3,488,170

Marble imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other, in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	....	....	....	....	....	$192,514	$2,540	$51,978	$247,032
1868	....	....	....	....	....	309,750	4,403	85,783	399,936
1869	....	....	....	....	....	359,881	3,898	101,309	465,088
1870	....	....	....	....	....	332,839	3,713	142,785	479,337
1871	$5,973	$168	$77	$44	$28	400,158	1,134	118,016	525,598
1872	3,499	1,081	452	....	318	475,718	4,017	54,539	539,624
1873	3,124	21	....	....	....	396,671	4,148	69,991	473,955
1874	1,837	....	....	....	....	474,680	2,863	51,699	531,079
1875	1,456	427	96	....	....	527,628	1,623	72,389	603,619
1876	595	126	203	87	....	529,126	1,151	60,596	591,884
1877	2,124	....	....	....	....	349,590	1,404	77,293	430,411
1878	198	11	8	....	....	376,936	592	43,915	421,660
1879	184	....	....	....	....	329,155	427	54,857	384,623
1880	....	....	....	....	....	531,908	7,239	62,715	601,862
1881	339	....	....	....	....	470,047	1,468	82,046	553,900
1882	655	....	....	....	....	486,331	3,582	84,577	575,145
1883	619	....	....	....	....	533,096	2,011	71,905	607,631

During the calendar years ending December 31, from 1886 to 1890, and fiscal years ending June 30, for 1884 and 1885, the classification has been as follows:

Marble imported and entered for consumption in the United States from 1884 to 1890.

Classification.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
In block, rough or squared, of all kinds	$511,287	$429,186	$408,895	$355,648	$357,220	$498,275	$510,354
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles	12,941	43,923	96,625	142,405	107,957	115,909	142,653
All manufactures of, not specially enumerated	67,829	54,772	44,053	31,880	69,086	61,231	132,376
Total	592,057	527,881	549,573	529,933	534,263	675,415	785,383

SLATE.

Production.—Slate valued at a total of $3,482,513 was produced in the United States during 1889. Twelve States contributed to this product as follows:

Production of slate in the United States in 1889, by States.

Rank.	States.	Value of output.
1	Pennsylvania	$2,011,726
2	Vermont	842,013
3	Maine	219,500
4	New York	126,603
5	Virginia	113,079
6	Maryland	110,008
7	California	18,089
8	Georgia	15,330
9	New Jersey	10,925
10	Michigan	15,240
11	Arkansas	
12	Utah	
	Total	3,482,513

Uses.—By far the greater portion of the slate produced in this country is used for roofing purposes, the value of the slate thus used in 1889 being $2,797,904, while that devoted to other purposes was valued at $684,609.

BLUESTONE.

Production.—This variety of sandstone was produced in only three States, the total value of the product being $1,689,606, divided as follows:

Production of bluestone in the United States in 1889, by States.

Rank.	States.	Value of output.
1	New York	$1,303,321
2	Pennsylvania	377,735
3	New Jersey	8,550
	Total	1,689,606

Uses.—Originally bluestone was used for flagging only, to which purpose the larger portion is still applied, but the use of it has extended to other purposes, such as rubble masonry, retaining walls and bridge stone, sidewalks, curbing, gutters, stepstones, flooring, vault covers, bases of tombstones, porch and hitching posts, and house trimmings.

ALABAMA.

The kinds of stone produced in this State are, in the order of their commercial importance, limestone and sandstone.

Limestone.—This comes from twenty-one quarries, distributed over the following counties: Shelby, $87,540; Colbert, $69,494; Lee, $52,500; Blount, $42,000; Franklin, $28,586; De Kalb, $16,333; Etowah, $13,567; Jefferson, $10,000, and smaller amounts in Jackson and Talladega counties. The value of the entire product as sold, including the value of the lime made from it, was $324,814. Of this amount the value of lime produced was $178,248. Other uses to which the stone is put are, in order of importance, blast-furnace flux, building, and street work.

Analysis of limestone from Chewacla, Lee county.

	Per cent.
Calcium carbonate	57.73
Magnesium carbonate	41.58
Ferric oxide and alumina	.12
Siliceous matter	.89
Total	100.32

Sandstone.—The amount produced in 1889 was valued at $43,965. The stone comes mainly from Jefferson county, with a product of $28,500, and small amounts from Colbert and St. Clair counties. It is used principally in the erection of buildings, a small quantity being devoted to bridge, dam, and railroad work.

New and prospective developments.—Marble has been found near Florence, Lauderdale county, 1 mile from the Louisville and Nashville railroad, and it is possible that developments may be made at this point. The Shelby Lime and Cement Company opened a new limestone quarry in February, 1890. The Cherokee Stone and Railroad Company opened a sandstone quarry in Colbert county in the fall of the same year.

ARIZONA.

Sandstone and limestone in small quantity are produced, the former in Maricopa and Yavapai counties and the latter in Gila county. The product is used locally.

New and prospective developments.—Messrs. Murphy and Austin, of Prescott, operated to a limited extent quarries of brown and lilac sandstone in 1890. The completion of prospective railroad facilities will increase their operations.

ARKANSAS.

The kinds of stone produced in this State are, sandstone, $25,074; limestone, $18,360; granite and slate in small amounts.

Sandstone.—The counties producing sandstone are, in the order of their importance, Johnson, Sebastian, Conway, and Miller. The product is used mainly for building purposes, although some is devoted to street and railroad work.

Limestone,—Limestone comes from Independence, Benton, Washington, and Carroll counties, and is used chiefly for burning into lime.

Granite..—The production of this stone is limited to Pulaski and Saline counties, and has extended over only a few years; but the outlook for larger operations in the future is good. The granites of Arkansas, which are, exactly speaking, syenites, are known as the Fourche Mountain or Little Rock, the Saline county and the Magnet Cove syenites. The first of these groups forms the Fourche mountain, a few miles south of Little Rock, and contains the so-called blue granite, which is an elæolitic augite hornblende syenite, and some gray granite, which is a light-gray cross-grained elæolite syenite. The blue granite has already become a very important building stone, and it is also used in the manufacture of paving blocks. The gray granite has been produced to a small extent. The Saline County region contains almost exclusively elæolite syenite of a reddish or grayish color, which has found little or no market on account of its distance from the railroad. The rock of the third region is worked to some small extent in building railroad culverts and foundations of houses. The following tests were made in the mechanical laboratory at the Rensselaer Polytechnic Institute at Troy, New York, on a 50,000-pound Tinois-Olsen testing machine. The specimens were cubical in form and were cushioned with pieces of bookbinders' board about three-sixteenths of an inch in thickness. They broke suddenly with an explosive force and in some cases the small fragments tore the heavy binders' board completely to pieces. In regard to the stone from Fourche mountain, it may be said that it is easily quarried, occuring in long ridges 200 to 300 feet in height, and by opening a quarry on the side of any one of these easy access to the stone is obtained, and perfect drainage and a convenient dump may be had at a minimum of cost.

Results of tests of Arkansas syenites.

Number.	Description of specimens.*	County where found.	Area of surface.	Actual crushing load.	Pressure per square inch.	Reduced to correspond to pressure per square inch in two-inch cubes.	Ratio of absorption—1 to —	Specific gravity at 60° F.
			Sq. in	*Pounds.*	*Pounds.*	*Pounds.*		
1	Light colored elæolite syenite, slightly decomposed	Saline	2.34	48,000	20,500	22,350	761	2.62
2	"Gray granite," a very light-colored elæolite syenite	Pulaski	2.25	33,750	14,000	16,000	83	2.45
3	Brownish elæolite porphyry, occurs in narrow dikes	do	1.42	30,000	21,000	24,980	161	2.52
4	"Light-blue granite" (syenite)	do	1.64	47,000	28,700	33,280	....	....
5	"Light-blue granite" (syenite), somewhat darker	do	1.07	22,800	21,500	26,820	....	....
6	"Light-blue granite" (syenite), still darker	do	1.57	35,950	22,900	26,745	1,673	2.64
7	"Medium blue granite" (syenite)	do	1.50	43,500	29,000	34,150	....	....
8	"Dark blue granite" (syenite porphyry)	do	1.57	43,800	27,900	32,630	4,530	2.69
	Mean of last five specimens. Average for "blue granite"	do	....	....	26,000	30,740	....	....

Slate.—A small quantity was quarried in Pulaski county in 1889. There is good reason to anticipate an increased production in the future.

New and prospective developments.—Variegated marble is found in Marion county, and Mr. L. Matlock, of Yelville, opened a quarry of it in the summer of 1890. A large area of marble outcroppings has been traced out and mapped in the region north of the Boston mountains in this State. These marbles are susceptible of a high polish and are of several shades of red, pink, and variegated. They are said to compare favorably with the Tennessee marble, but investigations and developments have not yet proceeded to a point which justifies more definite statements as to the future. The American Onyx Company, of Kansas City, Missouri, opened a marble quarry in Benton county in the summer of 1890.

In northern Arkansas, according to the Geological Survey at present being conducted under the direction of Mr. John C. Branner, State geologist, there are six distinct beds of limestone. Each of these six beds will furnish good building material. The upper bed in places will furnish marble, although the greater part of it has little commercial value. The third bed in the series furnishes an excellent building stone at almost every outcrop, and it is found throughout nearly all the northern counties. It corresponds quite closely with the Indiana oölitic limestone, being in the same geological horizon and resembling it in structure, except that it is more crystalline and takes a finer polish than the Bedford, Indiana, stone. It is more crystalline, less oölitic, and more fossiliferous in the western than in the eastern part of the bed. It has been quarried at Batesville, Independence county, for building stone and burning into lime. The fourth bed in the series, belonging to the Trenton period, occupies the same geological position as the Tennessee marble, which it resembles in structure and appearance. It has been traced and carefully mapped through Independence, Izard, Stone, Searcy, Marion, and parts of Newton and Boone counties. It is known to exist also in Madison and Carroll counties, and possibly extends as far west as the State line or beyond. Small quantities only have been quarried for local use in monuments and mantels. It varies in color through light gray, pink, red, variegated, and mottled. The fifth bed is found in great quantities in Independence, Izard, Stone, and Searcy counties. It is a fair building material and burns to produce good lime. Some lithographic stone has been obtained from it.

CALIFORNIA.

Until within a comparatively few years the demand for stone in this State has not been very great, and consequently the development and growth of the California industry is by no means in proportion to the resources in stone of all kinds which the State has revealed and which have been recognized and known for a long time. Most of the buildings of the State have been of pine or redwood, the abundance, accessibility, and cheapness of which have caused their general adoption. The mild climate has also tended to retard the adoption of the more substantial stone in the erection of dwellings. Insufficient facilities for transportation have naturally also been an obstacle in the way of quarry development, and in some localities where fine stone is abundant and accessible this drawback will be felt for years to come.

Even where the demand for stone becomes as great in comparison with other building materials as could possibly be expected, the number of large cities in California and neighboring States is insufficient to offer inducements for the development of more than a small fraction of the valuable quarry property known to exist, and shipments to remote points will have to be made before production will be commensurate with the possibilities. Such shipments are, however, by no means out of the question in view of the fact that a larger amount of eastern stone is shipped to California than would ordinarily be suspected. This is notably the case with slate, and to some extent also with other kinds of stone produced at eastern quarrying centers. This State produces the following kinds of stone, named in the order of their commercial importance: Granite, limestone, marble, and slate.

Granite.—This comes from 76 quarries in the following counties, named according to the value of output: Placer, Sacramento, Sonoma, Alameda, Fresno, San Bernardino, Solano, Humboldt, San Diego, Tulare, Nevada, Los Angeles, Marin, and Calaveras. It is thus evident that granite is quarried at points scattered over an area extending from the extreme northern to the extreme southern part of the State. The great bulk of the product comes, however, from the first five counties, four of which are near Sacramento and San Francisco. The total output for the State in 1889 was valued at $1,329,018. Of this amount Placer county produced $299,000 worth; Sacramento, $289,000; Sonoma, $215,000; Alameda, $142,000, and Fresno, $120,000. Somewhat less than half of the output is used for street paving and a slightly smaller quantity for ordinary building purposes. The granite quarries in the southern part of the State, while capable of producing large quantities of good stone, depend for their demand upon the southern portion of the State, and consequently the production will be necessarily limited until a wider territory of consumption is made available by a decided cheapening in transportation. In Fresno county are recently opened granite quarries 21 miles north of Berendo. Large developments are promised, the stone being so situated as to be accessible and easily handled. It is not regarded as a monumental stone, but it does not stain and answers very well for building. Large quantities of fine granite are to be found at Declezville, Victor and Riverside in San Bernardino county; and at Temecula in San Diego county. In Placer county, Rocklin and Lincoln are the most important producing centers. The stone from these quarries takes a brilliant and lasting polish and is quite popular with builders. Quarries have been operated for about twenty years at Rocklin, Lincoln, Loomis, and Penryn. The Central Pacific railroad takes about 90 per cent. of the product to San Francisco. At Penryn the latest improvements for finishing and polishing granite are to be found in more complete condition than at any other locality in the State.

The Folsom quarries of Sacramento county are at a point 1 mile above the town of Folsom City, which is 20 miles from Sacramento. Stone from these quarries has been used in the construction of the stone viaduct at Mare Island navy-yard, and also at the State capitol in Sacramento. It also enters largely into the stone buildings in San Francisco. These quarries lie for 2 miles on both sides of the American river. In this vicinity one of the prisons of the State is located. A large dam constructed of granite across the American river was completed in December, 1890. The labor was for the most part convict labor furnished by the State. This great work was commenced in 1866, but for a complication of reasons was somewhat delayed until 1888, when it was reundertaken and pushed with vigor. Most of the granite recently quarried has been used in the construction of this dam and also of the canal. The enormous water power which this dam will render available will be used in the prison and also in the city of Sacramento, where it is expected an important industrial era will be inaugurated by the utilization of power from this source. The dam and canal are the most substantial structures of the kind on the Pacific coast. It is the intention of the Granite Company operating at this point to put large quantities of stone upon the market as soon as the canal and dam operations are entirely completed.

The granite-quarrying operations of Sonoma county are practically limited to the production of basalt paving blocks, which has for years constituted an important industry in this county.

New and prospective developments.—During 1890 new granite quarries were opened by Mr. Matthew Lumber, of Rocklin. The Western Granite and Marble Company, of San José, the Carlow Brothers, of Sacramento, and the California Improvement Company, of Oakland, are all engaged in new developments of quarry property.

Sandstone.—In 1889 sandstone was produced to the value of $175,598 from fifteen quarries scattered over the following counties, named in order of output: Santa Clara, Amador, Ventura, San Bernardino, Yolo, Solano, and Napa. Of the total output Santa Clara yielded $100,000 worth; Amador county was second, with a product valued at $35,000. At San José a sandstone of light color and good quality is quite extensively quarried. It has been adopted upon the basis of its merits and its accessibility for use in the construction of the Stanford University. The Sespe Mountain sandstone of Ventura county is claimed to be the finest sandstone in the State, particularly for ornamental building.

Marble.—Four quarries in San Bernardino, Amador, Inyo, and San Louis Obispo counties produced in 1889, $87,030 worth of marble. Of the total output San Bernardino produced to the value of $78,000, by far the most of the entire product. It is thus evident that Southern California yields the bulk of the marble output of the State. The marble industry of California is in its infancy. The most advanced development is found in the quarries at Colton, San Bernardino county. Equipment for sawing, dressing, and polishing has just been completed. The stone is not what could be called strictly first class, but occasionally fine blocks are quarried. The quarries are so situated as to render operations easy and inexpensive. The developments in Inyo county are watched with interest. Shipments are steadily being made, and it is expected that railroad communication with Mojave will be made before long. Considerable prejudice among California marble workers against the marble of the State has had to be overcome, but, in view of the fact that the best quality of stone is not usually obtained near the surface, such unfavorable impressions are natural, but not always fair. Time must elapse before the stone can be fairly judged.

New and prospective developments.—The stockholders of the Carrara Marble Company in Amador county have been prospecting for a new railroad to their quarry. The marble from this quarry is regarded by certain experts in the State as the best to be found on the Pacific coast.

Slate.—Eighteen thousand dollars' worth of slate was produced from three quarries in El Dorado county in 1889. The product was used for quite a variety of purposes and appears to give entire satisfaction to the consumers. The demand for slate has been such in the past as to cause its importation from the East; the industry which has been opened up in the State ought therefore to thrive, and from present appearances it will grow steadily. At the Chili Bar slate quarry abundant water power is available, and while at present a large amount of dead work in stripping, etc., is to be done, the outlook for liberal production in the course of a year is exceedingly good.

Limestone.—Twenty-two quarries, scattered over eight counties in the State, produced limestone valued at a total of $516,780. Of this amount $513,130 represents the value of lime manufactured, so that it appears that only a small quantity of the total limestone production of the State goes for anything else than lime. The productive counties, named in order of value of output, are as follows: Santa Cruz, $266,650; San Bernardino, $74,000; Kern, $47,630; San Benito, $37,500; and smaller amounts in El Dorado, Santa Clara, San Diego, and Placer. The first-named county has for years been the principal producer of lime. Wood is abundant, cheap, and to be had immediately at the quarries. Transportation to San Francisco is by water. These advantages will probably enable Santa Clara county to maintain the lead for years to come. The most improved appliances are in use, and the lime is undoubtedly the best in the State. In San Benito county active operations have been inaugurated and the stone is of good quality. The following analyses of the limestone in this county have been made:

Analyses of limestone from San Benito county, California.

	Per cent.	Per cent.	Per cent.
Carbonate of calcium	96.00	99.2	99.0
Silica	2.10	.7	.5
Gypsum	Trace.	Trace.	Trace.
Total	98.10	99.9	99.5

The lime produced has to be hauled by twelve-horse teams to the railroad, thus adding to the cost of the lime; but it is said that this increase to the cost is largely offset by the ease of quarrying.

COLORADO.

The stone interests of Colorado have within a comparatively few years increased to very surprising proportions. The kinds of stone now produced are granite, limestone, and sandstone. The value of the stone output of this State in 1880 was only $50,400. The kinds of stone produced were sandstone and granite, the granite being valued at $41,400, while the value of the sandstone was only $9,000. The value of the stone output of Colorado in 1889 was $1,676,862. The developments are mainly due to the very much improved transportation facilities. The resources of this State are still undeveloped, and in almost all the varieties of stone produced for commercial purposes are very great.

Granite.—Ten quarries produced in 1889 an output valued at $314,673. This came from six counties of the State, named as follows, in order of value of output: Douglas, $200,049; Clear Creek, $75,000; Gunnison, $25,000; and much smaller amounts from Chaffee, Larimer, and Boulder counties. The great bulk of the product was used for general building purposes, a smaller amount being devoted to monumental and cemetery use, and a trifling quantity to street work. The counties producing granite are all in the central part of the State, running from the extreme northern limits to about half the distance to the southern boundary. The greater portion comes from counties in the neighborhood of Denver.

Sandstone.—In 1889 there were seventy-one quarries producing sandstone, the product of which was valued at a total of $1,224,098. The product came from the following counties, named in the order of their outputs: Boulder, $405,773; El Paso, $377,800; Larimer, $317,388; Eagle, $60,000; Jefferson, $41,496; and smaller quantities from Las Animas, Fremont, Park, Huerfano, and Montezuma. An amount valued at $703,477 was devoted to general building purposes. For street work the product used was valued at $509,955; the remainder was devoted to bridge, dam, and railroad work. The enormous strides made in the production of sandstone are largely due to the operations of the Union Pacific Railroad Company. This company not only quarried sandstone, but by the transportation facilities furnished to other quarries brought the industry to its present stage of advancement. Colorado sandstone is now being shipped to remote points and is becoming well known to the general trade.

The following is an analysis of sandstone from a quarry in Boulder county:

Analysis of Boulder county, Colorado, sandstone.

	Per cent.
Silica	95.37
Oxide of iron	2.40
Lime	.92
Magnesia	.50
Loss by ignition	.55
Total	99.74

Among the most important sandstones of the State may be especially mentioned that known as Peachblow. This stone has met with very favorable reception and appears to be of good quality and color. It has been well received in Chicago.

New and prospective developments.—The following firms opened new sandstone quarries in 1890: Messrs. Kirk, Cramer and Davis, of Breckenridge, Mr. William Coates, of Walsenburg, and Mr. C. S. Faurot, of Boulder.

Limestone.—The total value of the limestone output of 1889 was $138,091. Fifteen quarrries were productive. The product came from the following counties: Jefferson, $54,950; Boulder, $36,500; Pitkin, $24,127, and smaller amounts from Fremont, Pueblo, La Plata, and Larimer counties. The value of the lime produced in this State is $91,101. For flux the amount used was valued at $35,940. The balance was used for building purposes mainly.

Marble.—Although marble has not actually been quarried for market, the prospect for the development of this industry in the near future seems to be very good. Large masses of pure white marble are to be found on Whitehouse mountain near Marble city. Preliminary steps toward development have been taken. Gunnison county also contains marble deposits varying in color from pure white to jet black. Efforts are being made to secure the investment of capital for development. The marble deposits in Pleasant valley, northwest of Fort Collins, are of great interest, and some slight work of development has been attempted. The colors found at this place are red and pearl. This marble property is about 4 miles from the railroad and is easily accessible by an extension of the road.

CONNECTICUT.

This State produced granite, sandstone, and limestone in 1889.

Granite.—The granite output of Connecticut was valued at $1,061,202. It came from the following counties: New Haven, $421,246; New London, $313,508; Fairfield, $188,697; Litchfield, $60,425; Middlesex, $35,341; Windham, $26,968, and smaller amounts from Hartford and Tolland counties. The product was used for the most part for building purposes. The amount devoted to this purpose was valued at $758,915; for street work, including the value of all paving blocks, $109,261; for cemetery and ornamental work an amount valued at $111,155 was produced. For bridge purposes, $65,659, and a much smaller amount for miscellaneous uses was produced. Granite is produced in every county in the State. The most important, however, are those along the Sound coast.

Sandstone.—The total value of the Connecticut sandstone produced in 1889 was $920,061. By far the most of it came from the long known and celebrated brownstone quarries of Middlesex county. The counties in the order of the value of the product were: Middlesex, $871,476; New Haven, $40,495, and very much smaller amounts from New London and Hartford counties. The most important quarries are in the neighborhood of Cromwell and Middletown. The work is carried on on a large scale with the use of channeling machines. Some of the quarries have gone to a considerable depth. This stone has been extensively used in the largest cities of the East for many years, and it is so well known that it is unnecessary to touch upon the subject here at any great length. The principal quarries are at Portland and Middletown, on the east bank of the Connecticut river, in Middlesex county.

Limestone.—The value of the limestone output, including the value of lime made from it, produced in this State in 1889 is $131,697. It came from Litchfield and Fairfield counties, the amounts from each being respectively $87,342 and $44,355. By far the most of the product was burned into lime, the value of the lime being $129,663.

The following is an analysis of limestone from the Danbury Lime Company, whose quarry is in Fairfield county:

Analysis of limestone from Fairfield county, Connecticut.

	Per cent.
Lime	90.00
Silica	5.83
Alumina	3.90
Magnesia	.22
Total	99.95

New and prospective developments.—A new granite quarry was opened in 1890 by Mr. Patrick Garvey, of Bridgeport. The Totoket Granite Company, of New York City, began putting in a plant at the quarries at Stone creek in 1890. The quarries are not yet fairly in operation.

DELAWARE.

Granite to the value of $211,194 was taken from five quarries in New Castle county in the northeastern part of the State. An amount valued at $110,849 was devoted to bridge, dam, and railroad work, $67,202 in street work, and $32,443 for general building purposes.

FLORIDA.

Such a thing as the production of stone in this State has apparently been unheard of until careful investigation during the recent census developed the fact that Alachua county produced a small quantity of limestone for making jetties at the mouth of the St. Johns river. This stone is of course not the well-known coquina which has been used as a building material in this State in times long past.

Sandstone, flint, and limestone are reported as existing on the property of Mr. Louis Miller, of Sparr, Marion county. The sandstone has been quarried for local use.

GEORGIA.

Within the past few years the stone interests of this State have developed to a marked extent. The kinds of stone produced in 1889 were granite, sandstone, limestone, marble, and slate.

Granite.—Of these kinds, in point of value, granite was by far the most valuable, and it is interesting to know in this connection that while Georgia held twelfth place among the granite-producing States at the census of 1880 with a production of only $64,480 worth of granite, at the Eleventh Census it takes sixth place with a production of more than ten times as much, namely, $752,481 worth. This production in 1889 puts this State one place above New Hampshire, which has received the name of the "Granite State." The five States which produced more granite than Georgia in 1889 are: Massachusetts, Maine, California, Connecticut, and Rhode Island, in the order named. The granite-producing counties in the order of their importance are as follows: DeKalb, $606,075; Hancock, $68,083; Henry, $57,950, and very much smaller amounts in Bibb, Elbert, Spalding, Rockdale, Jones, Oglethorpe, and Newton. Of the total product in 1889, $347,100 worth went for building purposes and over $250,000 worth for street work. Smaller amounts were used for cemetery and bridge and railroad purposes. Among the most important granite quarries in the State may be mentioned those conducting operations at Lithonia and Stone Mount. At these places the granite is quarried with great ease, Stone mountain being simply an uninterrupted and solid mass of granite almost entirely devoid of soil. The granite is loosened by blasting and then split by hand drills and wedges. The cheapness of unskilled labor, which is contributed entirely by negroes, together with the ease of quarrying, make it possible for operators to compete favorably with other granite-producing centers. The granite from Lithonia and Stone mountain has been quite thoroughly tested and examined by scientific authorities of high repute. The results of these examinations are very favorable to the stone.

Marble.—The value of the marble produced in Georgia in 1889 was $196,250. Of this amount, $10,000 worth came from Cherokee county, and of the remainder by far the most of the product came from Pickens county. The developments of Georgia marble have all been made within the past six years.

The following is an analysis of Pickens county marble made by Mr. John C. Jackson, of Chicago:

Analysis of Pickens county, Georgia, marble.

	Per cent.
Calcium carbonate	97.32
Magnesium carbonate	1.60
Silica	.62
Iron protoxide	.26
Alumina	.25
Total	100.05

It finds its chief application in wainscoting, mantels, table tops, counters, panels, etc.—in other words for purposes of interior decoration. The Georgia Marble Company has a very fine plant, and the shipping facilities are about all that could be wished. A very decided demand for this marble in most of the large cities of the Union has arisen, and seems likely to increase markedly from year to year.

New and prospective developments.—Deposits of marble have been known to exist in Whitfield county. Capt. Charles C. Davis, of Chattanooga, Tennessee, has recently purchased 160 acres of quarry land, and it is his intention to open quarries at once. The United States Marble Company has recently been incorporated to develop marble quarries in the State. The capital stock of this company is $250,000.

Slate.—At the slate quarries at Rock Mart, Polk county, $15,330 worth of stone was produced in 1889. These slate quarries have been operated for twenty-five years. Up to 1883, the slate was all hauled a distance of 23 miles by wagon, and yet was sold at a profit, In 1883 the East Tennessee, Virginia, and Georgia railroad was completed, and in 1885 the East and West Alabama railway, so that transportation facilities are now exceedingly good. The slate deposits are estimated to cover an area of about 360 acres and near the junction of the two railroads above mentioned. From all that can be learned of these quarries, the investment of a larger amount of capital could be made to pay well. In 1889, a determined effort was made to secure the investment of about a quarter of a million in the slate deposits as well as marble deposits which exist in the neighborhood of Rock Mart. The methods of quarrying and manufacturing have hitherto been of the very crudest nature, and the introduction of more improved methods would doubtless result in a very decided cheapening of the cost per square of roofing slate.

Limestone.—From Catoosa county was produced limestone to the value of $24,656 in 1889; lime valued at $20,000 was produced, and the remainder was used for furnace flux.

Sandstone.—A small amount of sandstone was produced in Randolph county, but the amount was almost insignificant.

IDAHO.

The stone industry in Idaho amounts to comparatively very little at present. The chief product is limestone, which in 1889 was valued at $28,545, and came from three quarries in Kootenai, Bingham, and Alturas counties. Nearly the whole amount came from the first-named county and was entirely used for burning into lime. The lime is used entirely in neighboring towns.

Sandstone.—A small quantity of sandstone was produced in Ada county and was entirely used for building. The amount was insignificant.

Marble.—At Spring Basin, in Cassia county, marble was produced in sufficient quantities to supply local demands. The product is suitable for cemetery work, but it has never entered the market in competition with the well-known marbles of other regions.

ILLINOIS.

Limestone and sandstone have been produced in this State for some years. The latter, however, is of very small importance compared with the former.

Limestone.—The limestone produced in 1889 was valued at $2,190,607. This product was obtained from 104 quarries, operated in the following counties, named in the order of the value of output: Cook, $825,800; Will, $742,177; Adams, $91,000; Jersey, $73,000; Madison, $63,000;

Hardin, $58,000; Kane, $47,000; Pike, $42,000; Kankakee, $38,000; Hancock, $35,000; Saint Clair, $32,000; Winnebago, $26,000; Rock Island, $23,000; Henderson, $22,000; Du Page, $22,000; Randolph, $16,000, and smaller amounts in Union, Whiteside, Monroe, Ogle, Stephenson, Kendall, Jo Daviess, McHenry, Greene, and La Salle. It is evident that the first two named counties produce the great volume of the limestone, the amount from Cook and Will counties together being $1,567,977. Thus these two counties produce far more than the rest of the State put together. In the amount of limestone used for building purposes Illinois takes first place among the limestone-producing States. The amount devoted to building was valued at $1,084,556. In the amount of limestone devoted to street work Illinois stands second among the limestone-producing States. The amount thus used was $505,576. The value of the lime produced from limestone in this State, included in the total above given for the State, is $366,245. As flux an amount valued at $166,507 was used; for bridge work and miscellaneous purposes an amount valued at $67,723. The operations in Cook and Will counties, on account of their magnitude, the general excellence of the stone produced, and the ease of quarrying and working out deserve special mention. The region embraced by these two counties is known generally as the Joliet region. It includes territory from about 5 miles south of the city of Joliet to about 10 to 12 miles north, taking in the towns of Lockport and Lemont and running along the valley of the Illinois river. Most of the quarries are situated on the banks of either the river or the canal. The stone exists in layers at the surface, varying from 1 inch to 3 inches in thickness, and growing in thickness with the increasing depth until at about 25 feet it is found of a thickness varying from 15 to 20 inches. It is, however, rarely quarried below the 25-foot level, owing to the expense of getting it out and dressing it, since at that depth it is much harder, although the quality of the stone is superior to that in the upper levels. At the depth of 25 feet the inflow of water materially adds to the expenses of quarrying. The stone found at or near the surface is almost valueless and is almost entirely thrown away in stripping the quarry. The next two-fifths furnish stone of sufficiently good quality to be used for riprap, rubble, sidewalks, and curbing. The last two-fifths contain the best stone, namely, that used for building. It is generally of a bluish-gray color. The exposed stone is of a yellowish color from the effects of exposure to the atmosphere. It is also true that most of the Joliet stone turns more or less yellow upon exposure. The beds are divided vertically by seams occurring at somewhat irregular intervals of from 12 to 50 feet, and continue with quite smooth faces for long distances, and also by a second set of seams running nearly at right angles with the first, but only continuous between main joints and occurring at very irregular intervals. This structure renders the rock very easily quarried and obtainable in blocks of almost any required lateral dimensions.

The stone is easily worked into required shapes and takes a fine, smooth finish, and is susceptible of being readily planed. This forms a very rapid and cheap method of finishing flagging stones and preparing such as are to receive a smooth finish on the polishing bed. Enormous quantities of flagging stone are taken out, most of which goes into Chicago; but business with other cities is decidedly on the increase. The finest varieties are readily produced in forms which are capable of being turned out by lathes.

The following is an analysis of Cook county limestone:

Analysis of Cook county, Illinois, limestone.

	Per cent.
Silica	26.08
Alumina and oxide of iron	6.57
Carbonate of lime	46.90
Carbonate of magnesia	14.19
Water	6.26
Total	100.00

The crushing strength of this stone is 16,017 pounds to the square inch; specific gravity, 2.512. The stone obtained in the vicinity of the towns of Sterling, Morrison, Fulton, Cordova, and Port Huron is largely burned into lime. This is true of much of the stone all along the Mississippi river. The best grades of Alton stone become whiter upon exposure to the air, and some of it that has stood in buildings for twenty to twenty-five years has become almost perfectly white. The quarry at the Chester, Illinois, State prison is an immense bluff about 200 feet in height. It has been worked for only the past two or three years and is now turning out fine stone. All work is done by the convicts.

Sandstone.—The sandstone of Illinois comes from counties in the northwestern and western parts of the State. The total value of the product in 1889 was $17,896. It came from the following counties, named in order of output: Henry, Fulton, Whiteside, Union, Knox, Lee, and Clay. By far the most, however, came from Henry county. It was nearly all used for building purposes.

INDIANA.

The kinds of stone produced in this State are limestone and sandstone. Much progress has been made in the stone industry in the last ten years.

Limestone.—The limestone produced in 1889, including the value of the lime made from it, was valued at $1,889,336. The limestone industry is a very important one in this State. The productive counties are as follows, in the order of their relative magnitude: Lawrence, $506,471; Huntington, $228,679; Monroe, $195,632; Decatur, $169,195; Washington, $137,200; Ripley, $112,916; Owen, $74,227; Clark, $65,387; Franklin, $51,558; Putnam, $49,606; Wabash, $38,640, and smaller amounts from Shelby, Grant, Carroll, Cass, Delaware, Howard, Blackford, Madison, Harrison, Jennings, Adams, Floyd, Wells, Crawford, Jackson, Jay, Fayette, Miami, Randolph, Vanderburg, Wayne and White. The most productive portions of the State are the southern and southeastern. The product of these portions amounts to $1,312,586. The limestone of the State may for convenience be divided into three general classes: The oölitic limestone, otherwise known as cave limestone, from the numerous caverns which are to be found scattered through it; second, the harder and much more crystalline variety; and finally the rock which occurs in thin strata and which is well adapted for purposes of flagging, etc. The oölitic limestone extends in a southeastern direction from Greencastle in Putnam county. This stone is commonly known in trade as Indiana stone or Bedford stone and is wellknown over a wide area in the United States and is an exceedingly popular building stone, not only in cities of the West, but in Eastern cities as well. It has been most extensively quarried at Stinesville, Ellettsville, and Bloomington, Monroe county, and at Bedford in Lawrence county; but owing to the increased demand for this stone, new quarries are being opened and extensively worked at frequent intervals along the line of the Louisville, New Albany, and Chicago railroad, from Gosport to Bedford, and these give promise of rich and practically inexhaustible supplies. This stone is almost exclusively used for building purposes, and it is the great production of this stone which enables Indiana to take second place among the States producing limestone for building purposes, Illinois standing in the first place. The stone is characterized by its oölitic character, is comparatively soft when first removed from the quarry, but hardens on exposure to air. The deposit varies from a few feet to a great many in thickness and it is practically free from fissures. Solid walls 40 to 50 feet in depth have already been revealed without a seam or fault of any kind from top to bottom. It is easily quarried in blocks of any size required, being cut from the solid mass by means of channelers. It is soft enough to be readily sawed, ordinary steel blades, with sand as the abrasive material, being used for sawing. Occasionally diamond saws are used with fine results. For most part the stone is fine grained, but contains also layers of coarser material in which shells are easily recognized with the unaided eye. Operations in all quarries producing this kind of stone are conducted on the largest scale and the machinery employed is usually of the very best.

The harder, more crystalline stone is found in the eastern and southeastern parts of the State, principally in Decatur county in the southeastern part. The quarries in general are rather small, there being twenty of them in Decatur county alone. Some of the quarries are operated on a large scale, as, for example, the Greensburg Limestone Company, the Big Four Company, and a number of others. On account of its hardness this stone can not be sawed. It is used quite largely for building purposes. In the northern and northeastern portions of the State the stone is used somewhat for building and street purposes, and in Huntington county very largely for burning into lime. The great center of the lime industry is at Huntington, Huntington county. The most important concern producing lime at this point is the Western Lime Company. The product has a widespread reputation for use in building. On account of the flagging nature of the stone in the more northern portions of the State it is often quarried simply by aid of a pick and bar. This is more especially true in regard to the northeastern sections of the State. In the northern, northeastern, and eastern portions of Indiana are a great many small quarries. A number of them seem to be capable of more extended operations, but the lack of railroad facilities from the quarries to the main lines of travel exerts a retarding influence. The stone quarried at Greensburg, in Decatur county, is decidedly crystalline, and is susceptible of a high polish. The thin-bedded stone in the upper portions of these quarries is used to some extent for flagging. The development of the oölitic or Bedford stone is largely the result of operations conducted within a comparatively few years. In a small way it has been quarried and used for twenty-five years or more, but it is within the last twelve years that the stone has been recognized and appreciated by the larger cities of the East and West. It occupies at present a very prominent position among the best building stones of the country.

Considering the purposes to which the total limestone product of Indiana is devoted it appears that the value of the stone devoted to building purposes was $994,313; the value of lime manufactured, coming chiefly from Huntington county, was $340,315; to street and road work an amount valued at $316,722 was devoted; to bridge work and light foundations $233,710; and a small amount is used as flux. There are in all 172 limestone quarries in the State.

The following analyses may be found of interest:

Analysis of limestone from Adams county, Indiana.

	Per cent.
Carbonate of calcium	54.00
Carbonate of magnesium	45.00
Alumina	.46
Silica	.53
Iron	.01
Total	100.00

Analysis of limestone from Howard county, Indiana.

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Iron	.001	.001	.008	None.	None.
Carbonate of magnesium	Trace.	24.74	24.56	31.69	2.61
Carbonate of calcium	93.10	65.03	66.92	60.01	95.50
Insoluble matter incinerated	1.62	3.08	5.56	6.84	.90
Insoluble matter dried at 100°	1.74	8.73	7.63	7.03	1.82

Analysis of Lawrence county, Indiana, oölitic limestone.

	Per cent.
Lime	53.55
Carbonic acid	43.33
Water	.56
Magnesia	2.56
Iron	
Alumina	
Manganese	
Phosphoric acid	
Silica	
Total	100.00

Sandstone.—The sandstone produced in 1889 was valued at $43,983. It was produced in the four counties following: Warren, $19,163; Fountain, $14,500, and smaller amounts in Orange and Putnam counties. There are in all eleven quarries. Of the total amount produced, $16,033 worth was used for building purposes, whereas the entire product of Orange county was used for abrasive purposes. For bridge work, etc., an amount valued at $18,080 was used. The sandstone of Orange county deserves especial mention on account of its value for abrasive purposes. This stone is said to need no oil to soften it, but is used with water alone, and it appears to be very popular for the purpose of sharpening tools. It has been very highly recommended for razor hones and sharpening axes and knives. It is found chiefly in the western part of Orange county, and appears to be produced in no other county of the State. Much of it is shipped in the rough to the various points in New York to be sawed. There are no works with good facilities for sawing the stone in the vicinity of the quarries. The presence of petrifactions in these quarries occasions not a little trouble in working the stone.

IOWA.

Limestone and sandstone are produced in this State.

Limestone.—In 1889 the total value of the limestone product was $530,863. It came mainly from counties in the eastern and southeastern parts of the State. The limestone quarries are in a great many cases scarcely worthy of the name quarry, the operations being extremely limited and carried on frequently as work incidental to farming. There are comparatively few large operations in the State. It will, however, be noted that the value of the total output is considerable. The productive counties are as follows: Jackson, $97,600; Dubuque, $96,168; Cedar, $67,941; Marshall, $51,400; Jones, $37,880; Scott, $31,081; Lee, $20,093; Clinton, $14,631, and smaller amounts from Des Moines, Madison, Decatur, Cerro Gordo, Dallas, Wapello, Linn, Muscatine, Black Hawk, Mahaska, Washington, Benton, Clayton, Pocahontas, Montgomery, Tama, Floyd, Adams, Mitchell, Humboldt, Johnson, Jefferson, Clark, Van Buren, Howard, Taylor, Keokuk, Pottawattamie, Louisa, Webster, Allamakee, Story and Buchanan. The number of quarries is 143. Of the total product an amount valued at $236,792 was devoted to building purposes, while the value of the lime produced is $170,043. The remainder was divided between street and road work and bridge piers and foundations.

Sandstone.—Eleven quarries in this State produced sandstone valued at a total of $80,251. The productive counties are: Marion, $61,451, and Hardin, $10,197. The remainder producing small amounts are Cerro Gordo, Clayton, Lee, Jasper, Washington and Scott. The stone is almost entirely used for general building purposes.

New and prospective developments.—The following new limestone quarries were opened in 1890 by Mr. F. C. Chesterman, of Dubuque; Mr. Warren Bailey, of Cedar Falls, and Most & Stearns, of Humboldt.

KANSAS.

Limestone and sandstone were both produced in this State in 1889. The limestone was valued at $478,822, the sandstone at $149,289.

Limestone.—This comes from 115 quarries, many of them, however, very small, and contained in the following counties of the State: Cowley, $95,000; Leavenworth, $65,387; Marshall, $57,700; Chase, $53,000; Ripley, $52,000; Butler, 47,000; Lyon, $19,000; Wyandotte, $19,000; and smaller amounts from Marion, Atchison, Wabaunsee, Shawnee, Washington, Johnson, Russell, Dickinson, Franklin, Morris, Elk, Brown, Douglas, Republic, Pottawatamie, Coffey, Anderson, Jefferson, Ness, Montgomery, Jackson, Harper, Sumner, Ellsworth and Osage. The stone is pretty well distributed over the eastern portion of the State. Most of it, however, comes from the vicinity of Atchison, Leavenworth, Topeka, and Fort Scott. Of the total production an amount valued at $269,316 was used for building purposes. The value of the lime product is $9,013. For street work $97,502 worth was used; and for bridge, dam, and railroad work an amount valued at $102,991.

The following is an analysis of Cowley county limestone made by Prof. F. W. Clarke, of the U. S. Geological Survey:

Analysis of limestone from Cowley county, Kansas.

	Per cent.
Silica	5.27
Water	.78
Ferric oxide	.71
Ferrous oxide	.32
Alumina	1.07
Carbonic acid	40.34
Lime	50.36
Magnesia	.56
Sulphuric acid	.07
Phosphoric acid	.06
Soda	.20
Potassa	.10
Total	99.84

Matter dried at 100°.

According to the tests made in Washington a 2-inch cube crushed at 29,490 pounds.

Sandstone.—The sandstone product came from the following counties, named in order of value of output: Bourbon, $90,000; Phillips, $35,086; Rawlins, $18,000, and smaller amounts from Crawford, Woodson, Clark, Wilson, Kingman, Harper and Comanche counties. The sandstone is found in all parts of the State, but the most productive portions are in the south and southeast. The product was used mainly for street work, a smaller quantity being devoted to building purposes.

KENTUCKY.

Sandstone and limestone were produced in this State in 1889. The value of the limestone produced was $303,314, while that of the sandstone was $117,940.

Limestone.—The limestone comes from fifty-four quarries scattered over the following counties, named in order of output: Warren, $128,000; Jefferson, $76,000; Kenton; $36,000; Fayette, $17,300; Pendleton, $14,000; Lyon, $7,000, and smaller amounts from Jessamine, Menifee, Logan, Montgomery, Caldwell, Crittenden, Boyd, Marion, Hardin, Washington, Carter and Trigg. The purposes for which the stone was used were mainly for building, to which was devoted the amount valued at $187,570; $24,414 is the value of lime produced. To street work an amount valued at $86,054 was applied. Smaller amounts were used for flux and for bridge work. The product of Warren is deserving of special notice because of its peculiarities and its value as a building stone. This stone is known commercially as Bowling Green oölite. It is quite different from the oölitic stone of Indiana, inasmuch as it belongs to another limestone group, the constitutent globules being large and distinct, whereas in most of the Indiana stone they are minute. It is quite similar to the Portland oölite of Ireland. The following analyses of Bowling Green and Portland oölite show the similarity between the two:

Composition of Bowling Green, Kentucky, limestone compared with Portland, Ireland, limestone.

	Bowling Green.	Portland.
	Per cent.	*Per cent.*
Carbonate of lime	95.31	95.16
Carbonate of magnesia	1.12	1.20
Silica	1.42	1.20
Water and loss	1.76	1.94
Iron and alumina	.39	.50
Total	100.00	100.00

The quarries are of large extent, well equipped with channeling machines, derricks, etc. A mill with twelve gangs of saws finishes the stone. Blocks of almost any size can be furnished. These quarries were first opened in 1833, but until recently they were operated in the most primitive manner, and while the product has been used chiefly in the South, efforts are now being made to introduce the stone to the building trade of the northern States. Among the cities in which it has been most used are Louisville, Memphis, Nashville, and Bowling Green; to some extent also in Chicago. The stone is soft and easily worked, and like the Indiana stone hardens on exposure to the atmosphere. Carvings made upon the stone stand exposure to the air very well. Its color under the influence of sunlight tends to become continually lighter. Its crushing strength is such as to enable it to resist a pressure of 3,000 pounds to the square inch. When heated to redness on the surface and plunged into cold water it revealed no crack, even upon examination with a magnifying glass, and in some cases on being reheated for a second and third time and plunged into water still failed to present indications of cracking. According to present indications, the extended application of the stone in the northern and eastern portions of the country seems highly probable.

Sandstone.—The sandstone is produced from eleven quarries operated in seven counties of the State, namely: Rowan, $52,400, Muhlenberg, $25,000, Lewis, $24,900, Bell, $5,000, and smaller amounts from Crittenden, Rockcastle and Ohio. The greater portion of the stone, namely, $77,877 worth, was used for building purposes, $38,463 for bridge work, and a small quantity for street purposes.

MAINE.

The kinds of stone produced in this State, in order of commercial importance, are granite, limestone, and slate.

Granite.—In the value of granite produced in 1889 this State stood second in the list of all granite-producing States of the Union. The total value of the product was $2,225,839. The counties producing this product are, in order of their importance: Knox, $844,638, Hancock, $685,720, Waldo, $165,603, Kennebec, $136,270, Washington, $106,025, York, $88,567, Franklin, $72,033, and smaller amounts in Lincoln, Somerset, Penobscot, Cumberland, Androscoggin and Oxford. From the first seven counties above named comes the great bulk of the entire product. The most productive counties are those along the coast. The value of the granite devoted to building purposes is $839,125. In the value of stone devoted to this purpose Maine is second only to Massachusetts, but in the value of stone devoted to street work, it stands first among all the granite-producing States, the total value of stone devoted to street work being $927,949. Of this amount $824,113 was the value of paving blocks, which were shipped to most of the large cities on the Atlantic coast, principally to New York. Considerable was devoted to cemetery and monumental work. Although Maine doubtless possesses much stone well adapted to these uses, it stands in fourth place among the granite-producing States in the value of output for these purposes, being preceded by Rhode Island, Massachusetts, and Vermont, in the order named. The vast resources of this State in granite have been utilized to only a small fraction of the possibilities. The quarries situated along the coast have great advantages in the matter of transportation, inasmuch as this is largely by water and freight rates are naturally low. The granite quarries offer very excellent conditions for being worked. The stone opens easily, having peculiar cohate joints that are such striking features of the syenite or granite of New England. Then there are generally at least two of these rift lines and there is a more or less complete division by what appear to be true beds as well as joints, so that the division of the rock is as complete as could be desired. At the same time the lines of weakness are not so numerous as to make the quarried masses in many cases too small for use, as is sometimes true of other regions. Many of the quarries on the coast are conducted on a very large scale with all the latest most improved facilities, not only for quarrying but for the subsequent handling and preparation of the stone for market. A shaft of granite 115 feet long and 10 feet square at the base and weighing 850 tons has recently been quarried. It is claimed to be the largest piece of stone ever quarried. It has not yet been utilized but is lying in the quarry yards at Vinal Haven. The color of the granite produced from quarries in Maine varies from light gray to black and red. From the commercial standpoint the most important are the lightest in color and the gray. The grain of the stone varies very much in size, that quarried at Augusta being quite fine, while the other extreme is seen in the product of the Biddeford quarries. The light-colored stone comes from Biddeford, Pownal, Norway, Lewiston, North Jay, and Augusta. In many cases the light-colored granite is interspersed with black spots of mica which render it unfit for fine work. Veins of quartz, and of quartz and feldspar are often quite troublesome. In many of the ledges, as for example those in Augusta, the stone lies in beds or sheets which are very easily loosened by a single blast. In many of the small quarries the method of quarrying and the tools employed are simple and have undergone little improvement. This, however, is not true of the largest plants for producing this stone. Stone from South Thomaston and St. George is very dark in color and in the latter town are quarries of black stone and the only ones worked to any extent in the western portion of the State. The black granite is largely worked into monuments and it presents very fine contrasts between the black, polished faces and the lighter-colored hammered parts. Quite a large number of small quarries are operated by men whose main occupation is farming, but who work quarries for a small part of the year and with few quarrymen. The usual method in such cases is to secure a few contracts after haying season and they are fulfilled before cold weather. Such firms as these rarely keep any books and it was extremely difficult to determine the exact amount of yearly business done by them.

Limestone.—The limestone of Maine, and which is converted entirely into lime, comes for the greater part from Knox county. Smaller quantities are also produced in Waldo and Penobscot counties. In this limestone region there are sixty quarries producing stone which is converted almost on the spot into lime. The total value of the lime produced in 1889 was $1,523,499. The stone is almost inexhaustible in quantity and is admirably adapted to the purpose for which it is used. Operations of quarrying consist simply in blasting by means of dynamite, which breaks the stone up at once into sizes suitable for use in the kilns. It is then hoisted out by means of improved cables and machinery and sent directly to the limekilns, which are favorably situated for transportation by water. The stone is partially crystalline, but very coarse grained. Fine crystals of calcite are very numerous and gypsum also occurs. The operations at the quarries near Rockland are all below the surface of the ground. The fuel used in the kilns is entirely wood, which is imported from Canada. The stone produced for burning into lime is not measured as such, but is measured only by the quantity of lime produced from it, so that in speaking of the amount of stone quarried the producers name the amounts of lime obtained from it, and the unit of measurement is a bushel or barrel of lime. The lime produced at Rockland is of fine character and is the standard lime of New York City, to which it is shipped in enormous quantities. Boston also forms an important market for the product.

Slate.—The slate product of Maine comes entirely from quarries in Piscataquis county. The output in 1889 was valued at $219,500 for roofing purposes. This slate is of very superior quality.

New and prospective developments.—New granite quarries were opened during 1890 by the following firms: Messrs. Graves Bros., Northeast Bar Harbor; Mr. J. P. Fogg, of Pownal, and the Norway Granite Company, of Norway.

MARYLAND.

Granite, limestone, marble, and slate are produced in this State.

Granite.—Twenty-two quarries in Baltimore, Cecil, and Howard counties were operated in 1889, producing an output valued at a total of $447,489. Of this amount Baltimore County yielded stone valued at $223,070; Cecil, $219,863; and a smaller amount came from Howard County. The granite quarry at Port Deposit has won a wide reputation for the satisfactory stone produced. Throughout the mass of this granite, as it occurs in the quarry, seams occur at intervals from about one-half inch to a number of feet, and while they are discernible only by an experienced eye, they are very valuable in the operations of quarrying and can be opened readily by means of wedge and feather. They frequently reveal a perfectly level surface, ready at once for use in building without the intervention of the stonecutter. The expense of preparing the rock for use in the wall is accordingly reduced. The stone is very hard, takes a beautiful polish, retains its color, and can be gotten out in enormous blocks, larger, indeed, than it is advisable under ordinary circumstances to handle. It was used in the construction of the piers of the Baltimore and Ohio railroad bridge across the Susquehanna river near Perryville, and has given entire satisfaction in this work.

New and prospective developments.—In the spring and summer of 1890 the following firms began the operation of granite quarries: E. S. Johnson, of Guilford; Benjamin Kepner, of Port Deposit; Oliver and Peach, Granite; and M. C. Pyle & Son, of Pylesville. The Maryland Granite Company was incorporated, with a capital stock of $200,000, in December, 1890. Its object is to operate granite quarries and to do a general stone-contracting business. They are said to have purchased 184 acres of land at Deer Creek for the development of granite. The African Granite Company was incorporated at Baltimore during 1890, with a capital stock of $30,000.

Sandstone.—Sandstone was produced in this State in 1889, in Allegany and Frederick counties, in small amounts, the total value of the product of the State being valued at only $10,605. The Potomac Red Sandstone Company is operating sandstone quarries on the Potomac river, about 20 miles above Washington, in Montgomery county. This stone has been quarried since 1884, but for a period of nine years previous to that date there was no production. This production was originally known as Seneca red sandstone. It has been used in quite a large number of buildings in Washington City, notably the Smithsonian Institution. From all the evidence which has been submitted, it appears to be one of the best red sandstones in the country. Many of the strong and unqualified indorsements of this stone appear as the favorable result of an investigation of a committee of Congress appointed to investigate the use of this stone in the construction of the War, State, and Navy Department building in Washington.

Limestone.—Ordinary limestone from thirty quarries was produced in 1889 to an amount valued at $164,860. The productive counties were the following: Baltimore, $102,350; Frederick, $38,296; Washington, $15,184; and much smaller amounts from Carroll, Allegany, and Howard counties. The great bulk of the product was used in the production of lime, which was valued at $148,432. The remainder was used for building and street work, and to some extent as a flux and in bridge and railroad work.

New and prospective developments.—The Frederick Lime Company, of Frederick county, has been incorporated with a capital stock of $50,000 to develop limestone quarries for the manufacture of lime. Operations began in November, 1890.

Slate.—The slate product of Maryland comes from what is known as the Peach Bottom region, in the northern part of Harford county, where there were five quarries in operation in 1889. They produced an output valued at $110,008. For a more detailed description of what is known as the Peach Bottom region and of the slate produced from it, see the report on Pennsylvania in this volume.

Marble.—The production of marble proper is limited to Baltimore county, at a number of points in the vicinity of Baltimore, along the Northern Central railroad. The total value of the output in 1889 was $119,675. In Harford county green serpentine was quarried from a single locality. While this is by no means marble in constitution, it is nevertheless used for purposes to which marble is continually applied, and it therefore enters into competition with marble in the market. This stone is an exceedingly valuable one for purposes of interior decoration and furniture tops. The quarry was opened in the year 1880, and has been in operation ever since that time.

The following is an analysis of Harford county serpentine made by Dr. F. A. Genth, of Philadelphia.

Analysis of serpentine from Harford county, Maryland.

	Per cent.
Silicic acid	40.06
Alumina	1.37
Chromic oxide	.20
Nickel oxide	.71
Ferrous oxide	3.43
Manganous oxide	.09
Magnesia	39.02
Water	12.10
Magnetic iron	3.02
Total	100.00

The specific gravity of the stone is 2.668; hardness, 4 on a scale of 10.

New and prospective developments.—The Texas Lime Company began operations in quarrying marble for the production of lime in February, 1890. The Lake Chrome and Mineral Company opened a serpentine quarry in Harford county early in 1890.

MASSACHUSETTS.

Granite, sandstone, limestone, and marble are produced in this State.

Granite.—In the granite industry Massachusetts stood in first place among the granite-producing States in 1880 as well as 1889. It will moreover probably continue to hold this position for some years to come. The value of the granite output, according to the Tenth Census, in 1880 was $1,329,315. The corresponding figures for 1889 are $2,503,503. There were in 1889, 151 quarries, distributed over the following counties, named in order of value of product: Essex, $778,366; Worcester, $751,413; Norfolk, $485,353; Middlesex, $172,161; Bristol, $164,337; Hampden, $112,849, and very small quantities also from Franklin and Hampshire counties. The product was most largely used for general building purposes, the value of the stone devoted to those purposes being $1,362,451. The value of the product devoted to cemetery uses was $497,438; for street work, $466,147. The remainder was devoted to bridge, dam, and railroad work, and to various miscellaneous uses. It is evident that the granite comes mainly from the counties along the eastern coast and principally from the northeastern part of the State.

Among the various granites of the State that quarried at Quincy, which is a bluish-gray syenite, is perhaps the most interesting. It was the first to acquire a reputation, and the success of the Quincy granite did much towards stimulating search for similar products in other parts of the State. The quarries on Cape Ann, in Essex county, are being very rapidly and successfully developed, the quality of the stone produced here leaving little to be desired. Transportation facilities at the Cape Ann quarries could hardly be better, in view of the fact that they are immediately on the coast and, furthermore, in immediate communication with the Old Colony railroad. There is still, however, considerable need of good harbors at this locality, and considerable money must yet be spent there before quarrying can increase as it should.

The products of Massachusetts granite are so well known all over the country that it is necessary to say but little here in regard to them. Stone for all purposes is shipped all over the United States. The methods of quarrying and of cutting and polishing the stone in vogue in this State are fully up to date.

The following is an analysis of Bradford red granite, made by L. P. Kinnicutt, Ph. D., of the Worcester Polytechnic Institute.

Analysis of Bradford, Massachusetts, red granite.

	Per cent.
Silica	72.73
Alumina and oxide of iron	16.95
Lime	1.05
Magnesia	trace.
Potassium oxide	8.15
Sodium oxide	.90
Loss and undetermined	.22
Total	100.00

The following is an analysis of Worcester granite. The analysis was made by Prof. C. F. Chandler, of New York.

Analysis of Worcester, Massachusetts, granite.

	Per cent.
Silica	76.07
Alumina	12.67
Iron peroxide	2.00
Manganese oxide	.03
Lime	.85
Magnesia	.10
Potash	4.71
Soda	3.37
Total	99.80

New and prospective developments.—New granite quarries were opened at various times in 1890 by the following firms: Messrs. Rowley & Hanscombe, of Lanesville; the Braintree Granite Company, of Boston; Messrs. Jones & Desmond, of West Quincy; Messrs. McDonald & Turner, of Quincy; the Old Colony Railroad Company, of Boston, and Messrs. Charles Johnson & Bros., of Quincy. Mr. J. T. Tank, of Providence, Rhode Island, opened a quarry in Worcester county.

Sandstone.—Sandstone was produced from 21 quarries, to an amount valued at $649,097. The most important county is Hampden, in which the product was valued at $563,179. Suffolk county produced an amount valued at $82,018, while very small amounts came from Norfolk and Hampshire counties. The product is almost entirely used for general building purposes.

The following is an analysis of so-called Maynard sandstone, made by Dr. L. P. Kinnicutt.

Analysis of Maynard, Massachusetts, sandstone.

	Per cent.
Silica	79.38
Oxide of iron	2.43
Alumina	8.75
Lime	2.57
Soda and potassa	4.08
Carbonic acid, water, and loss	2.79
Total	100.00

The following is an analysis of Worcester sandstone, made by Dr. L. P. Kinnicutt.

Analysis of Worcester, Massachusetts, sandstone.

	Per cent.
Silica	88.89
Alumina	5.95
Iron oxide	1.79
Manganese dioxide	.41
Lime	.27
Potassa and soda	.86
Carbonic acid, water, and loss	1.83
Total	100.00

The following is an analysis of Kibbe quartz sandstone, made by Prof. C. F. Chandler, of New York.

Analysis of Kibbe, Massachusetts, quartz sandstone.

	Per cent.
Silica	81.38
Alumina	9.44
Oxide of iron	3.54
Lime	.76
Oxide of manganese	.11
Magnesia	.28
Carbonic acid, water, and loss	4.49
Total	100.00

Limestone.—The linestone of Massachusetts comes from twelve quarries in Berkshire county, in the western part of the State. The total product in 1889 was valued at $119,978. Most of it was used for burning into lime. The remainder was devoted to building purposes and flux.

The following is an analysis of limestone from Berkshire county:

Analysis of Berkshire county, Massachusetts, limestone.

	Per cent.
Lime	95.66
Magnesia	.76
Oxide of iron and alumina	.17
Silica	1.14
Carbonic acid	None.
Loss at red heat (water)	3.00
Total	100.73

Marble.—Marble was produced in small amount at Lee, Berkshire county.

MICHIGAN.

In 1889 sandstone, limestone, and slate were produced in this State.

Sandstone.—This was valued at $246,570. By far the most important producing county is Houghton, which yielded a product valued at $165,000. Marquette county, with a product valued at $35,970 stood second, while smaller amounts were produced in Huron, Ionia, Ottawa and Hillsdale counties. Most of the product was used for building purposes, although it is important to note that $27,800 worth were used for abrasive purposes, Michigan being one of the three or four States producing good abrasive material.

Limestone.—Limestone valued at a total of $85,952 was produced in the following counties, named in order of their importance: Huron, $40,272; Wayne, $16,715; Emmet, $13,100; and smaller amounts from Monroe, Delta and Alpena counties. Most of the product was used for building purposes, although some was burned into lime, and a slightly larger quantity used for street work, the rest being devoted for fluxing uses.

Slate.—The value of the slate produced in Baraga county was $15,000.

Marble.—Marble has been discovered at Ishpeming, Marquette county, and is said to be of very fine quality, even comparing favorably with the Mexican onyx. It must be said, however, that no full and definite information is yet at hand in regard to this discovery.

MINNESOTA.

The advances made by this State in the stone industry since 1880 are very remarkable. According to the census of 1880 the total number of quarries in Minnesota was 41 for all kinds of stone, and the total value of the product in that year was $255,818. In 1889 there were 102 quarries producing limestone, granite, and sandstone. The total value of the product of all kinds of stone in that year was $1,102,008.

Granite.—The value of the granite produced in 1889 was $356,782. The product came from 23 quarries scattered over the following counties: Stearns, $139,265, Benton, $110,650, Bigstone, $95,000. Decidedly smaller quantities came from Sherburne, Morrison and Nicollet. The productive counties in 1880 were Benton, Sherburne and Chisago, and the product at that time was valued at $28,815. The figures speak plainly for themselves as to the great strides which have been made in granite production. The product was devoted most largely to building, the value of the stone thus used being $209,396; for street work an amount valued at $141,554 was applied. Comparatively very small amounts were devoted to cemetery and bridge work.

Sandstone.—The value of the sandstone output in 1880 was $41,150; in 1889 it was $131,979. The product came from seven quarries operated in the following counties: Pine, $89,750, Pipestone, $20,279, St. Louis, $13,950, and smaller amounts in Houston, Rock and Scott counties. Of the total value, $82,000 worth was devoted to building purposes and the remainder between street and bridge work. The developments which have been made in Pipestone county in what is commercially known as "Pipestone red jasper" are of particular interest. This is a metamorphic quartzite rock of intense hardness, varying in color from cherry to lavender or violet. Its extreme hardness is another important characteristic. The following analysis was made by Dr. C. T. Jackson:

Analysis of red pipestone from Pipestone county, Minnesota.

	Per cent.
Water	8.4
Silica	48.2
Alumina	28.2
Magnesia	6.0
Peroxide of iron	5.0
Oxide of manganese	.6
Carbonate of lime	2.6
Loss	1.0
Total	100.0

The following tests of this stone have been made:

Tests of Minnesota red pipestone.

Crushing strength	pounds per square inch	23,000
Specific gravity		2.8
Weight per cubic foot	pounds	170.6

On account of its color and desirable properties which tend to make the stone durable, it is quite popular as a building material and has already been used in the construction of quite a large number of important buildings.

Limestone.—In 1880 limestone was produced from thirty-three quarries scattered over eleven counties of the State. In 1889 the limestone came from seventy-two quarries contained in fifteen counties. Named in the order of the value of their output, these counties are as follows: Hennepin, $137,728; Blue Earth, $127,279; Ramsey, $103,929; Goodhue, $95,938; Le Sueur, $41,553; Scott, $34,030; Washington, $16,387; Winona, $13,695; Wabasha, $12,050; Rice, $9,700, and smaller amounts from Dodge, Houston, Brown, Fillmore and Olmsted. The total product was valued at $613,247. Of this an amount valued at $380,556 was used for building purposes, while $124,266 was the value of the lime produced. Smaller amounts were devoted to street and bridge work. The great bulk of the limestone comes from counties situated in the southeastern part of the State, where the cities of Minneapolis and Saint Paul form important outlets.

MISSOURI.

The kinds of stone produced in this State are granite, sandstone and limestone.

Granite.—The total value of the granite produced in 1889 is $500,642. The product came from four neighboring counties in the southeastern part of the State. They are as follows: Iron, $373,558; Wayne, $63,842; Saint François, $60,842, and smaller amounts from Madison county. There are ten quarries contained in this area. The stone was about equally divided between general building purposes and paving blocks. The value of the stone devoted to building is $219,518. The value of paving blocks produced is $216,986. To bridge, dam and railroad work an amount valued at $63,638 was applied. A very small quantity was devoted to cemetery uses. The granite-quarrying industry dates back to a short time previous to 1880, but it at present bids fair to develop into an industry of considerable importance to the State. The most extensive quarries are at Graniteville, Iron county. The various plants at this locality are well equipped and supplied with improved machinery. Many of the finest buildings in Saint Louis have been constructed of this stone. At Granite Bend, Wayne county, are extensive granite quarries well equipped. In 1887 a shaft 85 feet deep with drifts extending from the bottom of the shaft in various directions was sunk. It was then charged with 32,700 pounds of black powder. The result of the blast was such that they have stone enough broken up to supply the demands of the firm for fifty years. The cost of the blast was $16,000. Unquestionably the granite industry in Missouri, although at present in its infancy, may easily assume vast proportions in the near future.

Sandstone.—Sandstone valued at a total of $155,557 was quarried in the following counties of the State: Johnson, $100,184; St. Clair, $15,000; Cape Girardeau, $12,734, and smaller amounts in Carroll, Barton, Saline, Franklin, Vernon, Holt, Lewis, Buchanan and Henry counties.

Limestone.—The limestone industry in Missouri is a very large and important one. A product valued at $1,859,960 was produced in 1889. This includes the value of all lime produced, namely, to an amount valued at $465,390. The productive counties are the following: Saint Louis, $870,276; Jackson, $211,743; Marion, $151,908; Greene, $103,324; Buchanan, $82,301; Dade, $72,327; Pike, $68,127; Jasper, $41,000; Perry, $33,070; Clark, $28,563; Mercer, $26,287; Lawrence, $26,060; Callaway, $24,500; and smaller amounts in Jefferson, Lewis, Wright, Cape Girardeau, Livingston, Andrew, St. Charles, Macon, Clay, Pettis, Cole, Linn, Caldwell, Sullivan, Randolph, Ray, Harrison, Monroe, Saline, Boone, Henry, De Kalb, Webster and Nodaway. The purposes to which the product was devoted are as follows: For building purposes, $542,871; the value of lime produced, $465,390; for street work, $670,351; for bridge, dam, and railroad work, $169,720, and small amounts for flux and miscellaneous uses. It is evident that by far the most important county producing limestone is Saint Louis county. Many quarries in and around the city of Saint Louis are operated. The stone is used for purposes of heavy construction, such as bridge and railroad masonry, building, paving, macadam, riprap, and the manufacture of lime. It is of excellent quality and shows great strength. In some of the quarries steam drills are in use, but in most of them the old methods are adhered to. The manufacture of a superior quality of lime in Saint Louis has grown to be an immense industry. Most of the kilns are located just outside of the city limits; they are well equipped and numerous. The product is almost entirely used in Saint Louis.

The following are analyses of limestone from various localities:

Analysis of Marion county, Missouri, limestone.

[By Regis Chauvenet & Brother.]

	Per cent.
Silica	.08
Alumina and oxide of iron	.40
Magnesia	.02
Carbonate of lime	98.80
Total	99.30

These chemists state that this is the purest sample of limestone they have ever analyzed, leaving nothing to be desired for whiteness and purity.

Analysis of Ash Grove white lime.

[By Charles W. Eoff, chemist.]

	Per cent.
Carbonate of lime	99.815
Magnesia	Trace.
Alumina	.054
Oxide of manganese	Trace.
Oxide of iron	.011
Silicic acid	.12
Phosphoric acid	None.
Sulphuric acid	Trace.
Total	100.000

Analysis of Champion white limestone, Ash Grove, Missouri.

[By W. D. Church.]

	Per cent.
Carbonate of lime	92.750
Carbonate of magnesia	3.260
Silica and insoluble matter	.495
Alumina	.480
Oxide of iron	.400
Sulphate of calcium	Trace.
Water	.675
Alkalies and loss	1.940
Total	100.000

Analysis of limestone from Saint Louis county.

	Per cent.
Carbonate of lime	97.76
Carbonate of magnesia	.12
Insoluble matter	.26
Oxide of iron	.20
Total	98.34

Analysis of Lawrence county limestone.

[By J. F. Elson, of New Albany, Indiana.]

	Per cent.
Carbonate of lime	85.373
Carbonate of magnesia	12.112
Silica	1.289
Alumina	1.134
Iron	.001
Undetermined	.091
Total	100.000

In northern Missouri limestone is found in every county and is quarried to a greater or less extent over the entire region. With but a few exceptions the quarries are worked on a small scale. The product is used in the immediate vicinity for foundations, cellars, wells, etc. The quarries are generally owned and operated by farmers, who do no work beyond the immediate local demand. Lack of facilities for transportation makes quarrying too expensive to be entered into as a business. Quarries adjacent to Government works on the Missouri and Mississippi rivers have supplied quite an amount for riprap. At Ash Grove, Missouri, are very extensive limekilns. A large quantity of lime is manufactured of a superior quality. The demand for this lime is very great. It is largely shipped to Alabama, Tennessee, Texas, Arkansas and Kansas, besides being also very largely used in Missouri. Extensive plants for burning limestone into lime are operated at Springfield, the product being used in Springfield, Kansas City and Saint Louis. At Cape Girardeau a large quantity of lime of good quality is also produced. At this locality crude petroleum is used as fuel, and it is claimed that a whiter and stronger lime is obtained than can be produced by either wood or coal. The limestone quarries at Grafton produced stone which has been found most excellently adapted for foundation purposes. It is the stone chiefly used in the construction of the great Edes bridge across the Mississippi river.

Onyx.—Quite recently discoveries of onyx have been made in Crawford and Pulaski counties; also in Wright county a deposit has been discovered. A company has been formed to develop the industry and active work will soon be begun. This onyx is taken from what is known as the Ozark region, being found in caves in the Ozark mountains within 70 miles of Saint Louis.

MONTANA.

Granite.—Granite was produced from a single quarry in Lewis and Clarke county in comparatively small amount. It was entirely used for building purposes.

Limestone.—Limestone was produced to the value of $24,964 from four quarries situated, in the order of their values, in Jefferson, Missoula, Park and Cascade counties. Sixteen thousand dollars worth of the product was used as flux and a small quantity for burning into lime, and about $8,000 worth for building purposes.

Sandstone.—Six quarries at various localities in Deer Lodge, Cascade, Custer and Yellowstone counties produced sandstone valued at $31,648. It was entirely used for building. About half the product came from Deer Lodge county.

NEBRASKA.

Limestone only was produced in this State. The value of the output was in 1889, $207,019, including the value of lime produced from it.

The productive counties are as follows: Cass, $148,567; Gage, $24,552; Sarpy, $13,339, and smaller amounts from Nemaha, Jefferson, Pawnee and Thayer. Ninety thousand five hundred and forty-two dollars worth were used for building; $86,643 for street work, while for flux and bridge work smaller amounts were used. The product comes entirely from the southeastern part of the State.

NEVADA.

This State produced very small quantities of granite and sandstone.

The granite came from Washoe county. A new granite quarry was opened in September, 1890, by Mr. J. M. McCormick, of Reno.

The sandstone came from Ormsby county.

The product of this State was sufficient in amount for nothing more than building and street work in Carson City, to which probably the most of it went.

NEW HAMPSHIRE.

Granite.—The granite produced in this State in 1889 was valued at $727,531. The entire southern and middle parts of the State, with the exception of Belknap county, were productive of granite. There are seventy-eight quarries in the State, operating in the following counties: Carroll, $197,284; Cheshire, $189,590; Hillsboro, $182,847; Merrimac, $112,853; Strafford, $22,535, and smaller amounts in Grafton, Sullivan and Rockingham counties. Of the total product an amount valued at $324,567 was devoted to building purposes; to street work, $252,256. Of this latter value $87,569 was the value of the output of paving blocks. To cemetery and ornamental work an amount valued at $135,029 was used. For bridge and miscellaneous purposes an amount valued at $15,679 was used.

A resident of New Hampshire has developed a new use for granite, which consists in finely crushing the stone and afterwards molding it into the desired shape, and by the action of heat it is hardened and made to resemble closely the original granite, and it is said that to all appearances it is as strong and durable. Nothing can yet be said of the real value of this process, but experiments are yet being made.

New and prospective developments.—New granite quarries were opened in the spring, summer, and fall of 1890, by the following firms: Messrs. Bishop & Shalon, of Milford; Mr. William E. Elder, of Dover; Messrs. Lewis & Flanders, of Enfield; Mr. D. J. Winn, of Haverhill; the Troy Granite Company, of Worcester, Massachusetts (their quarry is located in Cheshire county, New Hampshire), and Mr. L. K. Hutchinson, of Milford.

Sandstone.—A trifling amount of sandstone, which, however, was entirely used for abrasive purposes, was produced in Grafton county in 1889.

NEW JERSEY.

Granite, sandstone, limestone, slate, and bluestone were produced in this State in 1889.

Granite.—The total value of the granite produced in New Jersey in 1889 was $425,673. It came mainly from the northern and northeastern parts of the State, and the markets for it are largely New York City and Jersey City. The productive counties, in order of importance, are as follows: Somerset, $86,250; Hudson, $81,500; Essex, $79,200; Sussex, $52,000; Passaic, $37,760; Mercer, $27,513; Hunterdon, $24,800, and smaller amounts in Union and Morris counties. There are in all twenty-three productive quarries. Of the total output an amount valued at $236,310 was devoted to street work, including the value of all paving blocks produced, which amounted to $168,555; to general building purposes an amount valued at $42,175; for bridge, dam, and railroad work, $147,063. A trifling amount was devoted to cemetery purposes.

New and prospective developments.—New quarries were opened in the spring and summer of 1890 by the following companies: The Waterloo Ice Company, of Newark; Thomas Nevins & Son, of Orange, and York & Bittenbender, of Belvidere.

Sandstone.—Sandstone was produced in 1889 to an amount valued at $597,309. It came from twenty-six quarries, scattered over the following counties, named in order of importance: Essex, $270,450; Hunterdon, $173,007; Mercer, $77,652; Passaic, $63,200; and Somerset, $13,000. The amount devoted to building purposes was valued at $486,788; for bridge, dam, and railroad work the amount used was $100,521.

Limestone.—The value of the limestone output of New Jersey in 1889 was $129,662. It came from 33 quarries operated in the following counties: Sussex, $72,529; Hunterdon, $37,378, and smaller amounts in Warren, Somerset and Morris counties. The value of the lime produced was $99,406; for flux an amount valued at $29,620 was used, and a trifling amount for building. The following is an analysis of Hunterdon county limestone:

Analysis of Hunterdon county, New Jersey, limestone.

	Per cent.
Carbonate of lime	53.648
Silica	2.100
Carbonate of magnesia	40.750
Alumina	.252
Oxide of iron	.798
Total	97.548

This lime is especially valuable for fertilizing purposes.

Slate.—A small quantity of slate was produced in Sussex and Warren counties, New Jersey. Most of it was used for roofing purposes.

New and prospective developments.—A new slate quarry was opened by Messrs. Staton & Jones, at Lafayette, in the summer of 1890.

Bluestone.—Bluestone similar to that obtained in Pennsylvania and New York, and used mainly for flagging purposes, was produced in small quantities in Hunterdon and Sussex counties in 1889.

NEW MEXICO.

The kinds of stone produced in this Territory in 1889 were sandstone and limestone. The former was valued at $186,804, the latter at only $3,862.

Sandstone.—Sandstone was produced at eleven different quarries situated in the following counties, named in the order of their relative importance: San Miguel, $139,124; Santa Fé, $19,800; and Rio Arriba county, $14,100. Small amounts also were produced in Valencia and Lincoln counties. Nearly the entire product was used for local building purposes, a very small quantity being devoted to street and bridge work.

Limestone.—The small limestone output was obtained from the following four counties: San Miguel, Lincoln, Sierra, and Santa Fé. The product was mostly burned into lime for local consumption.

Ricolite.—This name was given by Mrs. L. J. Cadwell, of Chicago, to a stone now quarried in the western part of Grant county. It resembles Mexican onyx, but is quite different in composition. It is susceptible of a very high polish, and is of a variety of colors. It can also be carved, and in this respect, as in others, differs from the Mexican onyx. Contracts to supply this stone for interior decoration in a number of buildings in Chicago have been signed.

NEW YORK.

The kinds of stone produced in this State include granite, sandstone, bluestone, limestone, marble, and slate. Among the stone-producing States New York stands third, being preceded by Pennsylvania and Ohio in the order named. In the number of kinds of stone produced, however, it is second to none.

Granite.—The value of the granite output in 1889 was $222,773. The product comes from the following counties: Essex, $85,200; Richmond, $30,000; Orange, $29,803; Westchester, $16,000, and smaller amounts from Jefferson, Putnam and Rockland counties. The product was mainly used for building purposes, the amount devoted to these uses being valued at $149,700. The remainder was divided between street, cemetery and ornamental work and bridge, dam and railroad uses.

Sandstone.—The sandstone of New York includes that which is recognized to the trade under the names of sandstone, brownstone, and bluestone, while the variety of sandstone known commercially as bluestone is hereinafter given by itself on account of its peculiar character and its almost exclusive application in street work for curbing and flagging. The value of the sandstone proper, exclusive of bluestone, produced in

1889 was $702,419. The product came from sixty-three quarries scattered over the following counties: Orleans, $573,773; Saint Lawrence, $47,290, and smaller amounts from the following: Niagara, Oswego, Oneida, Jefferson, Chenango, Monroe, Allegany, Greene, Rockland, Washington, Tioga, Steuben, Schuyler, Franklin, Wyoming, Essex, Chautauqua, Otsego and Cattaraugus. Of the total amount produced, the value of that devoted to street work was $459,158; to general building purposes an amount valued at $241,216. A comparatively very small amount was devoted to bridge and miscellaneous work. As will be seen by an inspection of the productive counties, the greater part comes from the northwestern part of the State.

Among the sandstones deserving of special mention is what is known as the Potsdam red sandstone. This stone has been most thoroughly tested and has won a wide reputation for durability and its capacity to withstand the effects of strong heat and sudden cooling. It has been indorsed in a very unqualified manner by many of the leading authorities on structural material in the country.

New and prospective developments.—The following firms opened sandstone quarries in New York during 1890: Messrs. McVay, Tobin & Co., of Holley, Orleans county; Mr. Edward Jones, of Hulberton, New York, opened a sandstone quarry at Murray, Orleans county; Baldwin & Hinds, of Hindsburg, opened a sandstone quarry in Orleans county.

Bluestone.—This is the name given to the variety of sandstone which consists almost entirely of granules of silica cemented together by silica. The identity of this stone with sandstone is not generally recognized among the bluestone producers, and, in fact, many of them seem almost hurt if it is called sandstone. The bluestone industry is entirely distinct from what is herein given as the sandstone industry. Owing to the hardness and durability of bluestone, as well as the manner in which it occurs in the earth, it is well adapted to purposes of street paving, such as flagging and curbing, and most of it is devoted to these uses. A certain amount of the stone is quarried from regular organized quarries, with a definitely invested capital and plant, or facilities for quarrying, but in addition to stone taken from these regularly operated quarries a large amount is produced irregularly and spasmodically by men who invest no capital and have no definite organization as producers of stone. Their operations are conducted as follows: Provided with a very simple equipment of the most ordinary quarry tools they dislodge the stone found on land belonging to other persons and transport it to a number of shipping points, selling it there to dealers who make it a business to collect the stone in this manner and then ship it to the places where it is used. The dealers pay the individuals who quarry the stone an amount which simply compensates them for their time and labor, while the owner of the property receives a certain definite percentage from the dealer for the amount of stone thus taken from his land. During the year 1889, and a number of years previous, some of the dealers at various points in New York State constituted the members of the Union Bluestone Company, with headquarters in New York city. Each member of this company was entitled to furnish a certain percentage of the total amount sold by this company in a given year. The dealers may, therefore, be regarded in a certain sense as producers. The land on which this stone is quarried is, generally speaking, of little value for anything but the bluestone contained in it. Originally, the stone was quarried for flagging only, but more recently it has been applied to quite a long list of purposes, such as rubble masonry, retaining walls and bridge stone, curbing, gutters, stepstones, flooring, vault covers, bases of tombstones, porch and hitching posts, house trimmings, such as platforms, steps, door and window sills, lintels and caps.

The stone is known commercially by quite a number of names which designate approximately the region from which it is taken. Among the names in common use may be mentioned the following: Hudson River bluestone, Hudson River flagging, North River bluestone, North River flagging, Pennsylvania bluestone, Wyoming Valley bluestone, Delaware River bluestone, Delaware flags, bluestone flagging and bluestone.

The value of the bluestone produced in New York in 1889 was $1,303,321. This product came from 142 quarries in addition to numerous minor quarries or holes from which the product was taken by laborers, as has already been described. The productive counties are seen in the following list: Ulster, $662,324; Delaware, $150,866; Chenango, $93,100; Sullivan, $87,930; Wyoming, $50,260; Schenectady, $47,906; Orange, $33,405; Albany, $23,285, and smaller amounts from Otsego, Jefferson, Tompkins, Schoharie, Steuben, Seneca, Greene, Chemung, Broome, Saratoga, Oneida, Rockland, Franklin, Washington and Yates. The Union Bluestone Company, as organized in 1889, has dissolved.

New and prospective developments.—Messrs. Swartwout & Terry, of Read's Creek, Delaware county, and Mr. John McQuirk, of Hartwood, Sullivan county, New York, opened bluestone quarries during 1890.

Limestone.—Limestone, including the value of the lime made from it, was produced in 1889 to the value of $1,708,830. The product came from 157 quarries distributed as shown in the following list of counties: Erie, $331,011; Onondaga, $180,849; Washington, $172,987; Ulster, $107,683; Rockland, $104,000; Warren, $103,600; Montgomery, $95,319; Monroe, $94,891; Westchester, $83,313, and smaller amounts from Jefferson, Schoharie, Clinton, Niagara, Genesee, Cayuga, Albany, Oneida, Greene, Saint Lawrence, Orange, Saratoga, Lewis, Herkimer, Wayne, Seneca, Orleans, Essex, Fulton, Rensselaer, Madison, Otsego, Yates and Wyoming. The value of the lime produced is $837,613. The stone used for building was valued at $444,291. For street and road work an amount valued at $197,091 was used, and for bridge, dam and railroad work $175,736 worth.

New and prospective developments.—The following firms opened limestone quarries in 1890: Messrs. Schumacher & Edwards, of Buffalo, at Eggertsville, Erie county; Mr. J. H. Gould, Smiths Landing, Greene county; and Messrs. Andrews, Warner & Co., of Le Roy, Genesee county.

Marble.—The value of the marble output of this State in 1889 was $354,197. The product came from thirteen quarries, operated in four counties of the State. They are as follows: St. Lawrence, $138,200; Westchester, $135,104; Columbia, $54,717; and Warren, $26,176. The St. Lawrence county marble varies from white to dark blue and green in color, and mixtures of these shades produce in some cases a mottled appearance. The stone is adapted to monumental work, but is mainly used for building purposes. In general it is too coarsely crystalline for fine carving, scroll work, or tracing. In Westchester county the most important localities producing marble are Tuckahoe and Pleasantville. This product is especially well adapted for use in the preparation of carbonic acid.

New and prospective developments.—The following persons opened marble quarries during 1890: Mr. Mark W. Spaulding, Rensselaer Falls, Saint Lawrence county; Mr. Thomas S. Clarkson, Potsdam, Saint Lawrence county; and Mr. John Webb, jr., Gouverneur, Saint Lawrence county. Mr. M. W. Spaulding, of Rensselaer Falls, also opened a serpentine marble quarry in July, 1890.

Slate.—The slate output of New York State in 1889 was valued at $126,603. The product came from sixteen quarries in Washington county. This is the only locality in the world at which red slate is produced. The prices received for this variety of slate are much better than those which hold for the product from the neighboring slate regions of Vermont.

New and prospective developments.—Messrs. R. R. Jones & Co., of Middle Granville, Washington county, N. Y., opened a slate quarry during 1890.

NORTH CAROLINA.

Granite and a very small quantity of sandstone were produced in 1889. The granite was valued at $146,627, and was obtained from twenty-two quarries scattered over the following counties, named in the order of their outputs: Vance, $88,737; Iredell, $22,860; Anson, $10,000, and smaller amounts from McDowell, Rowan, Guilford, Gaston, Burke, and Wake counties. Of the total output $44,000 worth was used for bridge work, $42,000 for street work, and the rest was distributed between building and cemetery purposes.

New and prospective developments.—Three quarries of granite in the vicinity of Salisbury have recently been opened. The Stone Mountain Granite Company recently commenced operations in Rowan county. It is expected that quarries will be developed according to the most improved methods, with a view of supplying local demands and also of putting the stone upon the market in competition with granite from Northern centers. Near Mount Ayre the Mount Ayre Granite Company has commenced quarrying operations on quite a large scale for the purpose of supplying paving blocks for a number of cities, among which may be specially mentioned Cincinnati, Ohio. The recently organized Dunn Mountain Granite Company, of Salisbury, is about to commence the development of granite quarries in that locality.

Sandstone.—A recent scientific examination of Moore county brown stone, contained in property in the vicinity of Carthage, has been made by Mr. Henry E. Colton, of Chattanooga, Tennessee. The results of this examination are decidedly favorable to the quality of the stone. It is probable that quarrying operations will be undertaken in the near future. The stone is so situated as to be quarried with a minimum of expense.

Marble.—A large deposit of white marble in McDowell county has been examined by experts and is reported both as being of fine quality and of large extent. A plant valued at $50,000 has recently been established for the purpose of quarrying marble in Cherokee county.

Slate.—Deposits of slate in Montgomery county have recently been discovered, and steps toward their development have been taken by Mr. C. C. Wade. The North Carolina Slate Company has recently applied to the legislature of the State for an act of incorporation.

OHIO.

The kinds of stone produced in this State are exclusively sandstone and limestone. The total output of sandstone in 1889 was valued at $3,046,656. In the production of sandstone Ohio stands in first place among the sandstone-producing States of the Union and second in the value of its total stone output. The next State in order in 1889 was Pennsylvania, with an output valued at $1,609,159. It is thus evident that Ohio not only occupied first place, but was largely in advance of the State standing second.

Sandstone.—One hundred and ninety-two quarries were operated in 1889. The product came from the following counties, named in the order of the value of their output: Cuyahoga, $1,118,409; Lorain, $1,067,240; Stark, $140,426; Scioto, $71,700; Washington, $59,736; Huron, $59,118; Fairfield, $57,162; Summit, $50,310; Trumbull, $41,440; Morrow, $41,037; Wayne, $29,250; Muskingum, $25,095, and smaller amounts from Crawford, Richland, Holmes, Harrison, Tuscarawas, Belmont, Jefferson, Mahoning, Erie, Delaware, Franklin, Lucas, Meigs, Montgomery, Ross, Licking, Guernsey, Columbiana, Perry, Portage, Wood, Ashland, Pike and Lawrence. It is evident that by far the most of the stone comes from Cuyahoga and Lorain counties, in the northern part of the State. The stone was used for the following purposes: Building, $1,846,918; abrasive purposes, $525,548; street work, $430,552, and the remainder was used for bridge, dam, and railroad work and for miscellaneous purposes. In the production of stone for abrasive purposes Ohio stands first. The total value of the stone produced in 1889 for these purposes was $580,000, so that it is evident that Ohio produces nearly the entire amount. Some of the sandstone quarries of Cuyahoga and Lorain counties are operated in a most thorough, complete, and economical manner; the latest appliances are in use, and for smoothness of working very few quarries in the country can compare with them. The operations of the Cleveland Stone Company are the most important. The use of the Knox system of blasting in the quarries of this company is attended with great success. The stone is of such a thoroughly homogenous character that the result of a blast by the Knox system is simply to move, slightly, large masses of stone without sprauling or weakening them in any manner. It might almost be said that one could stand upon the mass of rock while being blasted out without danger of personal injury.

The following are a number of analyses of sandstone taken from various quarries in the State:

Analyses of Ohio sandstone.

	No. 1. Buff.	No. 2. Berea.	No. 3. Euclid bluestone.	No. 4. Columbia.	No. 5. Elyria.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Silica	97.00	96.90	95.00	96.50	87.66
Alumina			2.50		1.72
Iron oxides	1.00	1.68	1.00		3.52
Lime	1.15	.55		1.00	.17
Magnesia					.20
Potash and soda	.64	.55		.50	
Carbonic acid, water, and loss	.21	.32	1.50	2.00	2.03
Total	100.00	100.00	100.00	100.00	100.00

No. 1 came from Amherst, Ohio; No. 2, from Berea; No. 3, from Euclid county; No. 4, from Columbia county, and No. 5, from Grafton, Ohio.

The analyses of Nos. 1 and 2 were made by Messrs. J. H. Salesbury and John Eisenmann, respectively, and No. 5 by Mr. F. F. Jewett.

The sandstone of Ohio is so well known all over the country as a building and grindstone material that it is necessary to say very little here in regard to its desirable qualities. It is shipped practically over the entire United States.

New and prospective developments.—Developments of new quarries are rapidly being made both by companies long established as well as by new ones which are forming from year to year. The following firms opened new sandstone quarries during 1890: Mr. T. S. Gerhard, of Independence Township, Cuyahoga county; Mr. J. M. Crouch, of Gann, Knox county; Mr. J. N. Kisner, of Warsaw, Coshocton county; Mr. R. G. Garver, of Wilmot, Stark county; the Youngstown Stone Company, of Youngstown, Mahoning county; Messrs. Richard & Dicky, of Mill Rock, Columbiana county, and Mr. H. M. Friend, of Summit Hill, Ross county. The Uniontown Firestone Company, of Uniontown, Pennsylvania, began to operate a sandstone quarry at New Lisbon, Columbiana county, in August of 1890.

Limestone.—The Ohio limestone, including the value of lime produced from it, amounted to a value of $1,514,934 in 1889. It came from the following counties, named in the order of their importance: Ottawa, $230,485; Stark, $132,821; Erie, $128,169; Clark, $101,707; Miami, $91,810; Montgomery, $87,650; Wood, $79,799; Franklin, $76,778; Seneca, $68,772; Lucas, $53,568; Preble, $52,700; Sandusky, $52,122; Hamilton, $49,683; Allen, $42,515; Hancock, $37,253; Highland, $35,557; and smaller amounts from Greene, Hardin, Lawrence, Wyandotte, Butler, Delaware, Muskingum, Scioto, Shelby, Van Wert, Logan, Guernsey, Jackson, Putnam, Clermont, Crawford and Clinton. The value of the lime produced from the limestone of the State in 1889 was $581,325. For building purposes an amount valued at $407,388 was used; for street and road work the amount used was $183,235. An amount valued at $105,963 was used for flux. The remainder was devoted to bridge, dam and railroad work mainly. It is evident from the consideration of the productive counties that most of the limestone comes from the western part of the State, particularly the northwestern part.

The following analyses of limestone in Ohio are presented:

Analyses of Ohio limestone.

No.	Locality.	Carbonate of lime.	Carbonate of magnesia.	Alumina and oxide of iron.	Silica.	Organic matter.	Moisture.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Sandusky county	54.06	45.20	0.27	0.74		
2	Wood county	53.98	43.25	.43	1.53		
3	Seneca county	54.30	45.14	.16	.23		
4	Marble Head, Ottawa county	83.20	15.83		.15	0.02	0.80
5	Marble Cliff, Franklin county	81.14	16.00	1.08	1.94		
6	...do	93.28	2.69	2.18	1.41		
7	Kellys Island, Erie county	97.28	2.00	.27	.85		
8	...do	89.16	9.49	.25	1.05		
9	...do	87.35	10.68	.20	1.49		
10	Athens county	86.58	11.00	.32	2.10		
11	Fremont, Sandusky county	40.01	58.91	.50	.41		
12	Portage, Wood county	55.92	38.21	1.92	3.92		
13	Genoa	54.20	44.60	.79	.15		
14	Fostoria	55.41	42.99	.65	.21		
15	Put-in Bay, Ottawa county	59.28	38.52	.49	1.60		
16	Springfield, Clarke county	50.91	41.09	1.39	5.50		

The analyses of Nos. 1, 2, 3, 4, and 10 were made by Prof. Edward Orton, State geologist, Columbus, Ohio.

Analyses of limestone from Findlay, Hancock county, Ohio.

	Per cent.	Per cent.
Carbonate of lime	50.298	49.221
Carbonate of magnesia	42.000	37.337
Oxide of iron	2.021	4.101
Alumina	3.100	5.002
Silica	2.291	2.341
Sulphuric acid	Undetermined	1.285
Total	99.710	99.787

OREGON.

In 1889 Oregon produced granite, limestone, and sandstone.

Granite.—The counties producing granite are as follows: Columbia, Multnomah, Clackamas and Jackson. By far the most important is the first-named county, the product of which went entirely into paving blocks. Small quantities were used for building, cemetery purposes, and bridge work.

Limestone.—Forty-one thousand dollars is the value of both limestone and lime produced in Baker county, in the northwestern part of the State. It was used entirely for burning into lime and for flux.

Sandstone.—Sandstone was produced in Linn and Jackson counties in small amount. According to the tests which have been made, the sandstone appears to do very well as a cupola lining.

New and prospective developments.—Mr. L. M. Perkins, of Hudson, opened a new sandstone quarry in the summer of 1890.

Marble.—Extensive deposits of marble near Roseburg, Douglas county, have been opened by Messrs. Woodard & Willis, of that city. The product is said to resemble the famous Tennessee marble, and includes all colors. Future developments will have to determine the value of this discovery. The Variety Marble Company, of Roseburg, has put in machinery for the purpose of developing marble quarries in Douglas county.

PENNSYLVANIA.

Among all the States producing stone, Pennsylvania takes first place when all of the kinds of stone are considered, yielding a product valued at $7,319,199. The total value of the entire stone product of the United States in 1889 was $53,035,620. By comparing these figures, it will be noted that of the entire product Pennsylvania yielded 13.8 per cent. Its preëminence as a stone-producing State is due to the large amount of limestone and slate produced. In both of these kinds of stone Pennsylvania holds first place, and second place in the production of sandstone and bluestone. All of the various kinds of stone which are commercially distinguished from each other are produced in Pennsylvania. These kinds are, in the order of their relative importance for the State: Limestone, $2,655,477; slate, $2,011,726; sandstone, $1,609,159; granite, $623,252; bluestone, $377,735, and marble, $41,850.

Granite.—The total value of the granite output in 1889 was $623,252. This product came from sixty-four quarries contained in the following counties: Delaware, $122,279; Philadelphia, $108,736; Montgomery, $91,214; Bucks, $90,884; Chester, $66,398, and smaller amounts from Lancaster, Luzerne, Adams, Berks, Dauphin, Lehigh and York. Of the total output that devoted to street work is the most important, the value for this purpose being $292,114. For general building purposes an amount valued at $143,231 was used, and smaller amounts for bridge purposes. A little was used for cemetery work.

New and prospective developments.—Messrs. W. G. Cunningham & Co., of Philadelphia, opened a new granite quarry in Adams county in September, 1890.

Sandstone.—The total value of the sandstone produced in 1889 was $1,609,159. The product came from the following-named counties, the most productive of which are in the northwestern, western, and southwestern parts of the States. The productive counties, in the order of their importance, are as follows: Beaver, $344,038; Dauphin, $243,219; Lawrence, $130,973; Allegheny, $120,315; Westmoreland, $108,518; Montgomery, $87,994; Lackawanna, $72,260; Fayette, $68,602; Luzerne, $54,054; Somerset, $51,717; and smaller amounts from Huntingdon, Bucks, Chester, Tioga, Philadelphia, Lancaster, Indiana, Berks, Blair, Lehigh, Erie, Lebanon, Clearfield, Lycoming, Venango, Jefferson, Cambria, Warren, Elk, Crawford, Armstrong, Clarion, McKean, Delaware, Greene and Susquehanna. Scattered over these are 159 quarries. Most of the product was used for building purposes, the amount devoted to this use being valued at $777,123; for bridge work an amount valued at $496,902 was used; for street work, $175,062; to miscellaneous uses a smaller amount was devoted.

The following is an analysis made by Prof. Brenneman, of Ithaca, New York, of a sandstone from Luzerne county:

Analysis of sandstone from Luzerne county, Pennsylvania.

	Per cent.
Silica and insoluble matter	94.00
Ferric oxide	1.98
Lime	1.10
Magnesia	1.00
Volatile matter at red heat (water and carbonic acid)	1.92
Alumina	Trace.
Total	100.00

The specific gravity of this stone is 2.656.

Further tests made of this stone show it to be of fine quality, eminently fitted for street work.

Analysis of sandstone from McKee's Gap, Blair county, Pennsylvania.

	Per cent.
Silica	99.10
Iron and alumina	.60
Magnesia	Trace.
Loss on ignition	.25
Total	99.95

Below are given two analyses of sandstone from Fayette county. The quarry from which this stone was taken is operated by Messrs. W. C. & H. S. Drumm, of Layton's Station.

Analyses of sandstone from Fayette county, Pennsylvania.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Silica	96.54	99.46
Alumina	3.39	.45
Iron	.01	Trace.
Water	.06	.09
Total	100.00	100.00

No. 1 from Layton quarry.
No. 2 from Oakdale quarry.

New and prospective developments.—Sandstone quarries were opened in 1890 by the following firms: Messrs. Jute, Stratton & Foley, of Pittsburg, opened a sandstone quarry at Layton's Station. The Bellevue Land Company, of Washington, commenced operations upon a sandstone quarry; Mr. William E. Cunningham, of Pennsylvania, opened a brownstone quarry in Bucks county in December of 1890; Messrs. Robinson Brothers, of Homewood, Beaver county, began quarrying sandstone in August, 1890. The Middletown and Hummelstown Stone and Lime Company, of Middletown, began quarrying brownstone in the summer of 1890; Messrs. F. T. Scott's Sons, of York, opened a brownstone quarry in July, 1890; Messrs. Foster Brothers, of Allegheny, began quarrying brownstone at Homewood, Beaver county, in April, 1890.

Bluestone.—Bluestone is the name given to a variety of sandstone, which consists of grains or granules of silica cemented together by silica. This stone is used almost entirely for street work in the form of curbstones and flagging. It is quarried chiefly in New York State, although the product from Pennsylvania is scarcely to be distinguished from the New York stone, and enters into competition with it in the market. The total value of bluestone produced in Pennsylvania in 1889 was $377,735. It came from seventy-two quarries reported in the following counties: Susquehanna, $144,619; Pike, $126,250; Wyoming, $74,004; Bradford, $16,476; and much smaller amounts in Monroe, Wayne, Lackawanna, Schuylkill and Lycoming counties.

Limestone.—The total value of the limestone produced in Pennsylvania in 1889 was $2,655,477. Of the product, however, comparatively little was used as limestone itself, most of it being used for burning into lime and as blast-furnace flux. The productive counties, in order of their importance, are as follows: Montgomery, $475,572; Lawrence, $434,935; Chester, $321,680; Lebanon, $203,986; Lancaster, $184,962; Northampton, $171,674; York, $135,575; Berks, $129,651; Blair, $122,665; Lehigh, $85,559; Columbia, $66,738; and smaller amounts in Huntingdon, Adams, Dauphin, Mifflin, Cumberland, Bedford, Lycoming, Franklin, Montour, Allegheny, Union, Bucks, Armstrong, Northumberland, Somerset, Butler, Bradford, Beaver, Erie, Monroe, Crawford and Washington. For building purposes an amount valued at $238,431 was used. The value of the lime produced, a large portion of which went for agricultural purposes, was $1,195,955. For blast-furnace flux the value of the product consumed was $949,083. The remainder was used for street and bridge work chiefly. It is probable that the amount named above as consumed for flux is smaller than the true amount. This is due to the fact that considerable quantities of limestone are quarried by blast-furnace establishments for fluxing purposes, of which, apparently, a careful account is not in all cases kept.

The following are analyses of the so-called Acme Avondale limestone of Chester county. The analyses were made by Messrs. Booth, Garrett and Blair, of Philadelphia:

Analyses of Acme limestone from Chester county, Pennsylvania.

	Dark colored stone.	Light colored stone.
	Per cent.	*Per cent.*
Carbonate of lime	73.07	94.82
Carbonate of magnesia	5.58	1.10
Oxide of iron and alumina	1.27	.13
Insoluble matter	20.87	4.34
Total	100.79	100.39

This stone shows a tendency to become popular as building stone, and its qualities generally render it desirable.

The following are analyses of stone from Hyndman, Bedford county, Pennsylvania, made by Mr. Otto Wirth, of Pittsburg:

Analyses of limestone from Hyndman, Bedford county, Pennsylvania.

	Blue stone.	Fossil stone.
	Per cent.	*Per cent.*
Insoluble matter	4.14	2.70
Carbonate of lime	95.76	97.30
Total	99.90	100.00

The following is an analysis of a limestone from a quarry in Armstrong county:

Analysis of Armstrong county, Pennsylvania, limestone.

	Per cent.
Carbonate of lime	96.007
Carbonate of magnesia	1.498
Oxide of iron and alumina	1.462
Phosphorus	.034
Silica	.790
Total	99.791

The following is an analysis of limestone from Midvale, Franklin county, by Prof. William P. Tonry, of Baltimore, Maryland:

Analysis of limestone from Midvale, Pennsylvania.

	Per cent.
Carbonate of lime	94.427
Carbonate of magnesia	3.880
Silica	1.700
Total	100.007

The following is an analysis of Franklin county limestone:

Analysis of limestone from Franklin county, Pennsylvania.

	Per cent.
Calcium carbonate	92.079
Magnesium carbonate	4.420
Iron	1.420
Silica	2.130
Total	100.049

The following are analyses of limestone from Fayette county:

Analyses of Fayette county, Pennsylvania, limestone.

	Per cent.	Per cent.	Per cent.
Calcium carbonate	95.210	95.180	94.460
Magnesium carbonate	3.400	1.840	3.520
Phosphorus	.005	.004	.005
Insoluble matter	1.385	2.976	1.980
Total	100.000	100.000	99.965

The following is an analysis of limestone from Columbia county:

Analysis of Columbia county, Pennsylvania, limestone.

	Per cent.
Carbonate of lime	90.47
Silica	6.08
Oxide of iron and alumina	1.36
Carbonaceous matter and water	1.50
Carbonate of magnesia	.59
Total	100.00

The following are analyses of limestone from Lime Ridge, Columbia county, Pennsylvania, by Messrs. Booth, Garrett, and Blair, of Philadelphia:

Analyses of limestone from Lime Ridge, Columbia county, Pennsylvania.

No.	Carbonate of lime.	Carbonate of magnesia.	Oxide of iron and alumina.	Phosphorus.	Siliceous matter.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	88.450	4.782	.660	.020	6.26
2	82.371	7.791	1.190	.023	8.83
3	70.981	5.630	3.444	.032	19.51
4	92.314	3.901	.530	.006	3.34
5	96.125	1.767	.500	.006	1.86
6	94.267	1.934	.550	.020	3.48
7	93.378	2.004	.630	.014	4.17

The following is an analysis of gray limestone from a quarry in Lawrence county, made by Mr. Otto Wirth, of Pittsburg:

Analysis of gray limestone from Lawrence county, Pennsylvania.

	Per cent.
Carbonate of lime	95.25
Carbonate of magnesia	1.03
Oxide of iron	.91
Alumina	.74
Silica	2.03
Phosphoric acid	.04
Sulphuric acid	Trace.
Total	100.00

The following is an analysis of East Conshohocken stone, Conshohocken, Montgomery county:

Analysis of East Conshohocken limestone, Montgomery county, Pennsylvania.

	Per cent.
Lime	51.600
Magnesia	8.300
Alumina	10.000
Oxide of iron	3.600
Silica	26.200
Phosphorus	.040
Sulphuric acid	.400
Total	100.140

The following is an analysis of limestone from Lawrence county:

Analysis of Lawrence county, Pennsylvania, limestone.

	Per cent.
Carbonate of lime	95.070
Carbonate of magnesia	.750
Silica	2.240
Phosphoric acid	.052
Oxide of iron and alumina	1.620
Organic matter	.150
Manganese	.100
Total	99.982
Phosphorus	.023

The following is an analysis of limestone from Hellertown, Northampton county:

Analysis of limestone from Hellertown, Northampton county, Pennsylvania.

	Per cent.
Carbonate of lime	53.875
Carbonate of magnesia	25.494
Sesquioxide of iron	4.060
Alumina	6.090
Silica	5.470
Phosphoric acid	.089
Sulphuric acid	.174
Manganese	1.016
Water and organic matter	3.640
Total	99.908

New and prospective developments.—Mr. Joseph Gassert, of Lebanon, began quarrying limestone for burning into lime in February, 1890. Limestone quarries were also opened during 1890 by Mr. J. B. K. Richenbach, of Leesport, Berks county, and William E. Laut, of Lancaster, Lancaster county.

Slate.—The slate industry of this State, everything considered, is perhaps the most interesting subdivision of its stone industry. The slate industry is in by far the greater part limited to Pennsylvania and Vermont. The total value of all slate produced in the United States in 1889 was $3,482,513. The value of all slate produced in Pennsylvania in the same year was $2,011,726. The total value of all slate produced in the State of Vermont was $842,013. The importance of Pennsylvania as a slate-producing State is evident from these comparisons. While there is a great variety in the colors of the slate produced in Vermont, a similar statement does not apply to Pennsylvania, the product of which is entirely black, although a very fine distinction is locally made between black and a sort of bluish-black.

The actively quarried slate belt of Pennsylvania really begins in Sussex county, in the northeastern part of New Jersey, where, at La Fayette and Newton, there are slate quarries in operation, and also in Warren county, at Polkville. The Pennsylvania portion of this slate belt begins at the Delaware Water Gap, in the northeastern part of Northampton county, and extends through Northampton, Lehigh and Berks counties in a southwesterly direction. There is then a break filled up by Lebanon and Lancaster counties to the southwest, but in the southern part of York county operations in what is known as the Peach Bottom region reappear. Passing from the Delaware Water Gap in a southwesterly direction, the most important producing localities are as follows: Slateford, Mount Bethel, East Bangor, Pen Argyl, Wind Gap, Belfast, Edelman, Chapman Quarries, Treichlers, Danielsville, Walnutport, Slatington, Tripoli, Lynnport, Steinsville, and finally, in York county, a portion of what is known as the Peach Bottom region, which is for the most part in the northern part of

Harford county, Maryland. The most important localities in York county are West Bangor and Delta, which may be regarded as the principal points for the entire Peach Bottom region. The slate of Pennsylvania is frequently divided, more for commercial reasons than anything else, into the following regions: The Bangor region, the Lehigh, the Northampton Hard Vein, the Pen Argyl, and the Peach Bottom regions. The Bangor region is entirely within Northampton county, and is the most important. It includes quarries at Bangor, East Bangor, Mount Bethel, and Slateford; the Lehigh region includes Lehigh county entire, also a few quarries in Berks and Carbon counties, and also a small number of quarries in Northampton county on the side of the Lehigh river opposite Slatington; the Pen Argyl region embraces quarries at Pen Argyl and Wind Gap, in Northampton county. The Northampton Hard Vein region is especially distinguished on account of the extreme hardness of the slate as compared with that produced in other regions of the State. It includes the following localities: Chapman Quarries, Belfast, Edelman, Seemsville, and Treichlers, all in Northampton county. The Peach Bottom region includes four quarries in York county, Pennsylvania, and five in Harford county, Maryland.

One of the chief difficulties met with in quarrying the so-called "soft" slate of Pennsylvania is the occurrence of what are known as "ribbons." These ribbons are composed of foreign material and are exceedingly hard and interfere not a little with the smooth and economical quarrying of the slate. These ribbons are entirely wanting in the Peach Bottom slate, and this makes a great difference in the ease of quarrying in favor of the product of the Peach Bottom region. The slate produced at Chapman quarries and other localities quarrying the same kind of slate that is produced at this locality is so extremely hard that although it can be split with about the same readiness as the soft slate, it has to be sawed with diamond saws. This hardness is naturally an advantage to the slate, rendering it durable and nonabsorptive. For flagging purposes it is extremely adapted, chiefly on account of its hardness. The most important product into which this hard vein slate is made is roofing slate, although it finds considerable application for billiard tables, imposing stones, blackboards, cisterns, lintels, window sills, copings, ridgepoles, stairsteps, and floor tiles. For paving purposes it has given great satisfaction. For use in blackboards and school slates it does not appear to compare favorably with the output of Bangor and Lehigh.

Considering the slate product according to the counties, the following statement will suffice: Northampton, $1,467,653; Lehigh, $487,133; York, $36,558, and very much smaller amounts from Berks and Carbon counties. There are in all 104 quarries. The value of all the slate produced for roofing purposes in 1889 was $1,636,945; for other purposes the value amounted to $374,831. It appears to be generally acknowledged that for the sum total of desirable qualities for roofing, the Peach

Bottom slate is far ahead of that from any other locality in Pennsylvania. The advantages are its unchangeable color, and the smooth and glassy appearance which its presents upon the roof, together with great durability.

The production of slate according to the various regions which have been enumerated for Pennsylvania is as follows: The Bangor region, $707,162; Lehigh, $690,382; Northampton Hard Vein region, $184,595; Pen Argyl, $393,030; Peach Bottom, including, however, that produced in Maryland, $146,565.

The largest quarry in the State, and probably in the country, is the old Bangor quarry at Bangor. The dimensions of this quarry are 1,100 feet long, 350 feet wide, with an average depth of 175 feet. Operations are conducted on a very large scale here in every respect, two locomotive engines and a large number of cars being kept during a part of the year almost constantly employed in stripping and transporting the surface material to the dump.

Slate quarrying, not only in Pennsylvania but in all other States producing slate, is carried on almost entirely by the Welsh, in so far as skilled labor is concerned. This is of course due to the fact that operations of quarrying slate have been better studied in the enormous slate quarries of Wales than in any other part of the world, and naturally labor skilled in slate-quarrying comes from that country. For ordinary labor, such as stripping, Italians supply most of the demand. A large school-slate factory is in active operation at Bangor. In this factory the operations are carried on almost entirely by machinery, which is so perfect in its working that the manual labor required in attending to it is largely monopolized by children of both sexes. Similar statements may be made of large and prosperous school-slate factories in operation in Slatington and Walnutport. In the manufacture of roofing slate, boys are quite freely employed in the work of trimming the slates after they have been split to the proper thickness and approximate size. This practice enables the Welsh to keep the skilled work largely in their own hands, as they bring up their sons to learn the business after them, beginning with the light work of trimming, and as they grow older and stronger extending their work to the heavier operations.

Slate is well adapted for ornamental purposes after it has gone through the process of marbleizing. Quite a variety of stones and wood are thus imitated in a very successful manner. The following is a list of different kinds of stone which are thus imitated: Gray granite, Mexican onyx, fossil limestone, Devonshire marble, Tennessee marble, Circassian, Egyptian, and Pyrenees marble, and in fact all the better known varieties of variegated marble; also blue agate, red granite, red serpentine, the various kinds of woods, and petrified wood of California. As the industry progresses the number of different kinds of imitations increases. The slab to be marbleized is first rubbed by hand with fine sand, using a wooden block covered with cloth. The marbleizing process is done in two ways. For the marble having fine veins and lines running through it, like Spanish marbles, it is colored on a float, as it is called; that is to say, a large vat of water is sprinkled with the different oil paints required. The effect desired on the stone is thus produced on the surface of the water and is then transferred to the slab by simply immersing the slab and leaving the representation on it. According to the other method the coloring is done by hand, using brushes, sponges, and feathers to smear on the paint. In this process water colors are used. At this stage the slab is baked over night, the temperature of the oven or kiln varying from 175° F. to 225° F. After this first baking it is varnished, and the baking repeated. Next, it is scoured with ground pumice dust, varnished, and baked again. If any gilding is to be done, this is effected after coming out of the kiln for the third time. The next stage consists in rubbing with very fine pumice stone and a felt block, after which it is baked for the last time. Rubbing with rotten stone follows, and the final polish is put on by rubbing with the palm of the hand.

The purposes to which slate are applied are increasing quite rapidly from year to year. For quite a complete list of the uses to which slate is at present put, see the report on Vermont.

New and prospective developments.—Mr. George W. Geiser, of Easton, expected to develop slate property during 1890. Messrs. Jackson Brothers, of Pen Argyl, began operations upon a new slate quarry in the spring of 1890. The Doster Slate Company, of Bethlehem, organized late in 1889, began operations as slate producers in 1890.

Marble.—Marble was quarried in Montgomery county, at quarries near Conshohocken and King of Prussia. The total amount produced was valued at $41,850. It was used largely for building purposes, chiefly for steps, window sills, exterior trimmings of houses, etc. The waste is used as flux in iron furnaces and also in the manufacture of glass. The quarries have been operated for a number of years.

RHODE ISLAND.

Granite, sandstone, and limestone were produced in Rhode Island in 1889.

Granite.—The value of the granite output was $931,216. Rhode Island stands first among the granite-producing States in the value of granite devoted to monuments and general cemetery and decorative work. The productive counties are as follows: Washington, $737,456; Providence, $184,655, and smaller amounts from Newport and Kent counties. The value of the granite sold as cemetery and monumental stock was $588,199; for general building purposes $266,400 worth was used; for street work, including $45,817 as the value of paving blocks, an amount valued at $65,817 was used. The remainder was devoted to bridge, dam, and railroad work. The granite quarries and works located at Westerly, Washington county, have long been celebrated for the very fine ornamental stock produced. Most elaborately ornamented monuments and statues are turned out in great number. The plants for finishing and polishing are exceedingly well equipped, all the latest improvements in quarry tools being freely used. The stone is particularly well adapted for successful ornamentation and fine finish, and this accounts largely for the prominence of this branch of the granite industry in the State. In fine carving a pneumatic tool, striking exceedingly rapid blows and operated by heavy air pressure is becoming popular among granite-cutters. The rapidity with which fine work can be executed is very much increased by the use of this tool. Its value in connection with granite as well as with ornamental marble has already been satisfactorily demonstrated.

Sandstone.—Sandstone valued at $21,170 was produced in Providence county. The product was used entirely for building.

Limestone.—Providence county also yielded limestone and lime together valued at $27,625. Practically the whole amount was used for burning into lime, a very small quantity being used for flux.

SOUTH CAROLINA.

Granite and limestone were produced in this State in 1889.

Granite.—Nine quarries contained in Fairfield and Richland counties produced granite valued at $47,614. Nearly the entire product came from the first-named county. It was used mainly for street work, the remainder being divided up between building, cemetery, and bridge work.

New and prospective developments.—New granite quarries were opened during 1890 by the following: Mr. A. J. Gilbert, in the neighborhood of Bordeaux, Abbeville county; the Columbia Granite Construction and Manufacturing Company, of Columbia; and Mr. F. Hopperfield, of Yorkville, York county.

Limestone.—Limestone valued at $14,520 was produced in Abbeville and Spartanburg counties. It was used for bridge work and burning into lime.

Marble.—In 1889 Mr. O. E. Mayhew, of Columbia, discovered a bed of blue marble near Walhalla, Oconee county, and was taking steps to organize a stock company with a capital of $25,000 with the purpose of developing it.

SOUTH DAKOTA.

The kinds of stone produced in this State are granite, sandstone, and limestone.

Granite.—The granite product in 1889 was valued at $304,673. The entire amount came from Minnehaha county, in the southeastern part of the State. The product was divided in its application between paving blocks, valued at $170,695, and building, which consumed the remainder. Much of the stone classified here, for commercial reasons, as granite is really quartzite, a variety of sandstone.

Sandstone.—The production of sandstone in 1889 amounted to $93,570. It was produced at twelve quarries located in the following counties, the most important of which is the first-named: Fall River, Lawrence, Pennington and Custer. Of the total value, $81,941 worth was devoted to building purposes and the remainder to abrasive purposes. The above-mentioned counties are all in the southwestern part of the State. The following data were secured by Maj. John R. McGinnis, of the Ordnance Department, Rock Island Arsenal, Illinois. The stone was from Fall River county:

Tests of South Dakota sandstone.

Percentage of water absorbed	8.08
Specific gravity	2.47
Crushing strength, pounds per square inch	8,850

Another specimen gave:

Percentage of water absorbed	7.45
Crushing strength, pounds per square inch	5,200

New and prospective developments.—New sandstone quarries were opened in 1890 by the following companies: The Fall River Stone Company and the Norfolk Stone Company, at Hot Springs; Mr. Henry C. Ashe, of Sturgis county; and Messrs. Scott & Holmes, of Fairburn, in the southern Black Hills region of Custer county.

Limestone.—A very small quantity of limestone was produced in Custer county in the southwestern part of the State in 1889.

TENNESSEE.

The stone interests of this State center chiefly in the marble production of Knox, Loudon, and Hawkins counties. In addition to the production of marble, however, comparatively small quantities of limestone and sandstone were also produced during the year 1889.

Sandstone.—A small quantity of sandstone, valued at $2,722, was produced at four localities, situated in Giles, Marion, Campbell and Maury counties. It was almost entirely used for ordinary building purposes.

Limestone.—Limestone, valued at $73,028, was produced in 1889 from the following counties: Houston, $47,950; Davidson, $9,120, and smaller amounts from Maury, Montgomery, Hickman, Franklin and Marshall counties. Most of the product was used for conversion into lime, the lime produced being valued at $60,625. The remainder was divided up between the ordinary building, flux, and street work.

Marble.—The total value of the marble output of Tennessee in 1889 was $419,467. This product came from twenty-two quarries in Knox, Hawkins and Loudon counties. Of the total value, a product valued at $283,154 was produced in Knox county. The value of that from

Hawkins county was $103,813. The remainder, $32,500, came from Loudon county.

The marble-producing region of Tennessee is in the extreme eastern and northeastern parts of the State. Tennessee marble first came into notice about 1863, following immediately upon the close of the war. The first notable use to be made of it was in the United States Capitol building at Washington. Ever since the discovery of the product it has been valued chiefly for purposes of interior decoration and for use in furniture. The product from Hawkins county is the handsomest and brings a much higher price than the product from either Knox or Loudon county. The principal shipping point for the Hawkins county product is Whitesburg. The most important cities in the country for the manufacture of marble into furniture tops are Cincinnati, Ohio, and Baltimore, Maryland. The marble product of Tennessee is so generally well known for its attractive qualities that it is scarcely necessary to enter upon the subject further here. Judging from efforts which were being made to secure further investment of capital and to improve transportation facilities, greater strides will be made in the next few years in the marble regions of Tennessee than have been known heretofore. The consolidation of some six or seven previously independent firms into what is known as the Tennessee Producers' Marble Company will doubtless have the effect of stimulating the industry and preserving a definite grade of prices. The demand for the stone, particularly for interior decoration in dwellings as well as in public buildings, seems to be all that could be desired, and probably the condition of trade would stand a much more active development of the quarries than has heretofore been effected. Improvements in transportation facilities are sadly needed.

New and prospective developments.—The Awalt Marble Company, of Tullahoma, has been organized as a branch of the Tennessee Land and Improvement Company. It expects to commence the development of marble deposits in the vicinity of Tullahoma, Coffee county. Marble similar to Hawkins county marble has been discovered at Fountain City, a suburb of Knoxville, Knox county. It is expected that the Fountain City Land Company, which owns the property, will organize a company to develop the stone. The Athenian Marble Company has been incorporated for the purpose of developing marble quarries near Athens, McMinn county. Marble has been discovered recently in Marion county, a few miles from South Pittsburg. The product has been analyzed, and is pronounced of good quality, susceptible of high finish and of beautiful color.

Slate.—Although as yet no slate has been quarried in Tennessee, it is probable that this State will shortly become productive of this stone. The Tennessee Slate Company has been organized to quarry slate at a point between Chilhowee mountain and McGregor's Knob. The slate is regarded as of fine quality and suitable for roofing, as well as most of the other purposes to which slate is applied.

TEXAS.

Granite, sandstone, and limestone were produced in Texas in 1889. The stone industry of this State dates back for only a few years, no mention whatever being made of the production of stone in Texas in the Tenth Census report.

Granite.—Eight quarries in Burnet, Gillespie and Llano counties, all in the central part of the State, produced granite valued at $22,550. Almost the entire output was used for ordinary building, a very small quantity being devoted to cemetery purposes. The locality in Burnet county at which the granite for the new capitol was quarried is Marble Falls. The quarrying operations involved in obtaining stone for the capitol were largely conducted with convict labor. The amount of granite at this point is inexhaustible and appears to be of good quality. The presence of an enormous water power is an inducement for more extended quarrying operations than have yet been attempted The adoption of this stone for the new capitol is the best guaranty of its merit. It shows considerable variety in color, ranging from red or rose color—the stone of which the capitol was constructed—to a light gray, with various intermediate shades. It has shown a resistance to a pressure of 11,891 pounds to the square inch before crushing. At or near Marble Falls marble said to be of fine quality is found in large quantities. It has shown a crushing strength of 14,782 pounds to the square inch, the tests having been made by Col. D. W. Flagler at Rock Island, Illinois. It is said that quarrying operations could be conducted at small cost, as there is but little stripping to be done. One of the largest dams in the world is now in course of construction across the Colorado river just above the city of Austin. The principal stone used in the work is granite from the quarry near Marble Falls. The Houston and Texas railroad has secured control of the Austin and Northwestern railroad, running from Austin to Burnet and Marble Falls, has changed the gauge from narrow to standard, and gives a direct outlet from the quarry to the seaboard and to other railway transportation. This granite is also used to considerable extent for the jetty work at Galveston. Sandstone is also found at the same locality.

Sandstone.—The value of the sandstone produced in 1889 in Texas was $14,651. It was taken from seven quarries contained in the following counties named in order of relative outputs: Washington, Parker, Grimes, Llano, Brown, Collin and Wise. It was entirely used for building.

Limestone.—Limestone, valued at $217,835, including the value of lime made from a portion of it, was obtained from eighteen quarries contained in the following counties, named in order of their importance: Travis, $62,686; Hood, $50,000; Bell, $35,698; Grayson, $23,040; El Paso, $19,138, and smaller amounts from Washington, Lamar, Fannin, Lampasas, Coryell and Dallas. The product to the value of $135,901 was used for building. The value of the lime produced was $6,700. The remainder was used for flux, street, and bridge work.

The following is an analysis of limestone from El Paso county.

Analysis of limestone from El Paso county, Texas.

	Per cent.
Carbonate of calcium	97.50
Silica and trace of iron	2.50
Total	100.00

UTAH.

Sandstone valued at $48,306, limestone at $27,568, and granite at $8,700 were quarried in 1889.

Sandstone.—The sandstone output came from Utah, Summit, Emery, and Box Elder counties, nearly the entire amount coming from the first two named. The entire product was used for building in Salt Lake City, Provo City, and Ogden.

New and prospective developments.—Mr. H. W. Lawrence, of Salt Lake City, opened a sandstone quarry in February, 1891.

Limestone.—Limestone came from Salt Lake and San Pete counties, by far the greater part, however, from Salt Lake county. It was used mainly for burning into lime and for fluxing.

Granite.—A very small quantity of granite was produced in Salt Lake and Weber counties. The amount was small and was used mainly for building, although a little was devoted to cemetery work.

Marble.—The marble interests would apparently well repay more extended investigation than has been thus far devoted to them. There are marble beds south of Nephi which are said to be of good quality, although it has not yet been proved that they are capable of yielding large blocks free from flaws. Another deposit is the property of the Wasatch Marble Company on the divide between the heads of the Big Cottonwood and Snake creeks. The marble here covers many acres and is said to be hundreds of feet in thickness. It is white in color and free from cracks or stains. It is said that blocks could be taken out as large as it would be possible for the heaviest machinery to handle. Efforts are now being made to develop this property.

Slate.—Mr. F. W. C. Hathenbruck, of Provo City, commenced quarrying slate and serpentine during the summer of 1890.

VERMONT.

This State occupies a unique position in the United States in regard to the stone industry. This is due to the fact that it is the great marble-producing State of the Union, producing vastly more than all the rest of the country put together, and, secondly, to the fact that it is only second to Pennsylvania in the production of slate. The kinds of stone produced are granite, sandstone, limestone, marble, and slate.

Granite.—The total value of the granite produced in 1889 in this State was $581,870. The product came from 53 quarries in the following counties: By far the most important granite-producing county is Washington, the output of which was valued at $474,341; second is Windham county, with a product valued at $52,460. The remaining are: Orange, $24,100; Caledonia, $18,027; and smaller amounts from Chittenden, Orleans and Windsor counties. The most important developments of the last decade in this State are those which have been made at Barre. At this point there is an enormous supply of granite of the finest quality, such that the product is well adapted, not only to all the ordinary uses to which granite is put, but also for the finest kinds of monumental and decorative work, to which it is quite largely applied. The methods of quarrying are modern. In one of the quarries in this locality the Knox system of blasting is in very successful use. The application of this recent method of blasting granite is quite limited, and is not received with favor by a great many of the large producers of granite in this and other States. The objections to the system as applied to granite are probably, however, due more to the results of single, and in some cases, unsuccessful experiments than to long continued and fair trials of it. The amounts devoted to the various purposes to which granite is applied are: Cemetery and ornamental work, $412,287; ordinary building, $45,198; street work, $48,323; bridge work and miscellaneous uses, $76,062.

New and prospective developments.—The following firms have opened granite quarries during the year 1890: The Green Mountain Granite Company, at Barre; the Excelsior Granite Company, at Montpelier; Mr. Jacob B. Taylor, at Barre; and the Berlin Granite Company, at West Berlin.

Sandstone.—A very small quantity of sandstone for abrasive purposes was produced in Orleans county.

Limestone.—The total value of limestone and lime produced in 1889 was $195,066. Of this amount $168,808 was the value of the lime produced. For building purposes an amount valued at $5,010 was produced. The remainder was divided up between street and bridge work.

Marble.—As already stated, the marble output of Vermont amounts to more than is produced in all other localities in the United States. The total value of the marble product in 1889 was $2,169,560. This came from but three counties in the State: Rutland, $1,844,301; Bennington, $229,059; Franklin, $96,200. From this it is evident that the Rutland quarries produce nearly the entire output. The productive counties are all in the western part of the State, and, interrupted only by Chittenden county, extend from the Dorset quarry in the southwestern corner to the Champlain marbles at Swanton in the extreme northern part. The quarries now operated are in or near the towns of Manchester, Dorset, East Dorset, Wallingford, Rutland, West Rutland, Proctor, Pittsford, Brandon, Fair Haven, Middlebury, North

Ferrisburg and Swanton. Abandoned quarries are found all along the railroad from Dorset to Middlebury. The largest operators in the State are to be found at West Rutland and Proctor. At these places quarrying operations are carried on on an enormous scale with the very latest and most improved machinery, and taken all together they are the finest examples of economically quarried property to be found in the world. The abundant water power at Proctor is fully utilized in the operations of the large mills owned by the Vermont Marble Company. Power is transmitted largely through the medium of compressed air.

New and prospective developments.—The Taconic Marble Company was formed for the purpose of developing marble property in Bennington in the summer of 1890. Two quarries are now in working order and a considerable output may be looked for in 1891.

Slate.—The total value of the slate output in 1889 was $842,013. This product comes entirely from Rutland county. The area in which slate is actually produced at present is confined to a narrow strip in Washington county, New York, and a somewhat wider one lying next to it in Rutland county, Vermont. It extends from Castleton, Vermont, on the north, to Salem, New York, on the south, a distance of 35 or 40 miles, and has a maximum width of 6 miles, but the average is not more than a mile and a half. Scattered over this territory there are about forty-nine quarries in Vermont, and abandoned quarries or those which for one cause or another are at present idle number many more. The first commercial use to be made of the slate of this region was between thirty and forty years ago, when Messrs. Alanson and Ira Allen began on a small scale the manufacture of school slates from the stone obtained at Scotch Hills, 2 miles north of the village of Fair Haven. This quarry is still in operation. The industry has now reached large proportions, the number of quarries keeping pace with the demand for the stone, and this is steadily increasing as new purposes are found for its application. Besides its well-known adaptability for roofing, slate is used locally in a comparatively rough state for sidewalks, curbstones, hitching posts, underpinning, cellar walls, and door steps. As a manufactured article, after going through the mill, it is offered for the following purposes: Billiard-table beds, mantels, fireboards, register frames, radiator tops, steps and risers, platforms, tiles, wainscoting, moldings, thresholds, window sills, lintels, brackets, laundry tubs, washbowl tops, cisterns, sinks, urinals, refrigerators, blackboards, mangers, curriers' slabs, imposing stones, grave boxes, grave covers, headstones, grave markers, vault doors, water tables, belting courses, counter tops, brewers' vats, greenhouse shelves, chimney tops, switch boards, and panels for electric work. In the marbleizing process it is susceptible of considerable ornamentation, which makes it more desirable still for many of the above uses and also extends the list of its uses as follows: Table tops, stand tops, card-receivers, soda-water fountains, checker boards, doorplates, signs, and paper weights.

The slate differs somewhat in its physical properties, such as hardness, homogeneity, and cleavage, but the greatest variation is to be found in its color, no other place in the world showing as many colors in an area of equal size. Most of the commercial names under which the slate is sold are descriptive of the color of each kind and are as follows: Sea green, unfading green, uniform green, bright green, red, bright red, cherry red, purple, purple variegated, variegated and mottled.

The line dividing Vermont and New York also marks the division of two important varieties of slate. The true sea green is found only in the former State, while the red is entirely confined to the latter, some of the quarries producing the respective kinds being, however, but a few hundred yards apart. The sea-green slate is manufactured almost entirely into roofing slates, more than three times as many squares being made from it as from all other varieties combined. It is quarried very extensively in the villages of Pawlet and Poultney. The selling price per square is lower than for any other prominent kind quarried in the region, and the greater output results both from its predominence in the localities mentioned and from the ease with which it is worked, the split being remarkably pronounced. When first quarried its color is a pleasant grayish-green, but after being exposed to the weather it gradually fades and changes in a very unequal manner, certain sheets turning brown, others light gray, while some remain practically unchanged. A roof covered with it presents, after a year or two, a peculiar spotted appearance. It is, however, a good wearing slate and the objection to its color is the principal one against it.

As already stated, no red slate is produced in Vermont, while the red-slate quarries of New York, just across the dividing line, are the only ones in the world producing red slate.

New and prospective developments.—A movement was on foot in the latter part of 1890 to purchase all the sea-green slate quarries in Vermont. The syndicate is said to be backed by English capital and its ultimate object is to obtain control of the entire sea-green slate product of the world.

VIRGINIA.

The stone resources of this State are as yet comparatively undeveloped. The great drawbacks to progress in the stone industry have been lack of capital and facilities for transportation. Production at a not distant day in the future will probably far exceed anything that has yet been accomplished in any one year. The kinds of stone at present actually produced are granite, sandstone, limestone, slate, and marble.

Granite.—In 1889 thirteen quarries, scattered over six different counties, produced granite valued at $332,548. These counties and the value of stone produced in 1889 are as follows: Chesterfield, $135,916; Amherst, $59,125; Henrico, $55,507; Alexandria, $40,000;

Campbell, $27,000, and Dinwiddie, $15,000. The product was more largely used for building purposes than any other, the amount devoted to this purpose being valued at $120,467; $79,925 worth went for street work and the remainder was used chiefly for bridge and railroad work. A number of the quarries in the vicinity of Richmond have been operated successfully for quite a number of years. The plants are comparatively well equipped, and, while operations might be conducted upon a considerably larger scale, they may be said to be prosperous. The stone from most of these quarries is of good quality and is generally well received.

New and prospective developments.—The Rocky Mount Granite Company has recently purchased quarries near Rocky Mount, Franklin county, and apparently their intention is to materially increase operations at these quarries, which have previously been carried on by other parties. The Roanoke Granite Company, of not less than $35,000 capital, has recently been incorporated for the purpose of developing granite quarries in the State.

Sandstone.—The sandstone output of 1889 came from Campbell and Prince William counties and was valued at $11,500. It was entirely used for building purposes.

New and prospective developments.—A new sandstone quarry in the vicinity of Manassas, Prince William county, was commenced in 1890.

Limestone.—Eleven quarries in nine counties of the State produced limestone and lime together valued at $159,023. The productive counties are, in order of importance, Botetourt, $46,000; Alleghany, $45,646; Shenandoah, $27,295, and smaller amounts in Roanoke, Montgomery, Warren, Pulaski, Loudoun and Washington. The larger part of this product comes from quarries in the southwestern part of the State. The value of lime produced was $83,667. For fluxing, principally in blast furnaces, $48,146 worth was used. A small quantity was used for street and road purposes.

Slate.—The Virginia slate product comes entirely from Bingham county. The product in 1889 was valued at $113,079. The product enters the market in competition with that from the important regions of Pennsylvania and Vermont, and is well adapted for roofing and many of the other purposes to which slate is applied. Amherst county will doubtless produce slate before long. The Mount Ayre Slate Company is at present engaged in the development of a slate quarry near Scottsville, Albemarle county.

Marble.—The only marble produced in Virginia in 1889 was taken from a quarry in Mountsville, Loudoun county, by the Virginia Marble Company. Although considerable merchantable stone has been quarried, practically none has been sold, as it has been found impracticable to transport the product by wagons over the roads which connect the quarries with Leesburg, the nearest point on the railroad. There are prospects that a branch road connecting with the Chesapeake and

Ohio railroad may be built to the quarries, but until this is done the product can not be considered as on the market. For the purpose of interior decoration and furniture tops, the stone is undoubtedly very fine.

New and prospective developments.—Experts have examined the marble property in the neighborhood of Staunton. According to indications thus far, it is likely that quarrying operations,will be undertaken. Mr. J. S. Smith has just organized a stock company, with a capital of $100,000, to develop marble property near Fincastle, Botetourt County, and the preliminary operations of stripping have already begun.

WASHINGTON.

Limestone, sandstone and granite were produced in this State in 1889. The value of the limestone was $231,287. The bulk of the entire product comes from San Juan county, in the northwestern part of the State. Very small quantities were produced in Kitsap and Douglas counties. Practically nearly the whole product is used for burning into lime, small quantities being devoted to building and blast-furnace flux.

Sandstone.—The sandstone output was valued at $75,936. It is used entirely for building and comes from the following counties, named in order of their importance: Whatcom, $42,000; Thurston, $18,000; and Pierce, $15,936. According to investigations made by experts sent out by the Cleveland Stone Company, of Cleveland, Ohio, very fine sandstone in inexhaustible quantities has been revealed on the shores of Lake Whatcom.

Granite.—A small quantity of granite—$10,000 worth—was produced in Stevens county, in the northeastern part of the State. It was entirely used for building purposes. Mr. O. D. Guilfoil has recently opened a quarry of black granite in King county. Small shipments have been made.

WEST VIRGINIA.

Sandstone, valued at $140,687, and limestone, at $93,856, were produced in this State in 1889.

Sandstone.—The sandstone comes from the following counties, named in the order of their outputs: Kanawha $66,000; Wood, $18,839; Summers, $18,800; Ohio, $15,150; and smaller amounts from Marion, Lewis, Preston, Ritchie, Harrison, McDowell and Taylor. Most of the product was used for bridge, dam, and railroad work; $40,000 worth was used for building, and a smaller amount for street work. A large proportion of it was used in the city of Charleston, situated in Kanawha county.

Limestone.—The limestone comes mainly from Berkeley county, with a production of $61,000; $21,411 from Jefferson, and the remainder from Greenbrier. The total value of the product was $93,856. These counties are in the northeastern and southeastern parts of the State. The great bulk of the stone was used for burning into lime. Smaller amounts were used for flux, building, and railroad work. There are but eight operative quarries in the State. The value of the lime produced was $82,471.

There are large quantities of sandstone and limestone in West Virginia which have not yet been at all developed. There seems to be a decided need of increased capital and better railroad facilities. Near Martinsburg, in the northeastern part of the State, are the most important limestone quarries. At this place patent kilns are in use and a good quality of lime is produced. The Alderson brown stone quarries in Summers county yield a valuable stone, which is easily quarried and well adapted to building purposes and also for street work.

WISCONSIN.

Sixty quarries producing limestone and sandstone were operated in 1880. A total output valued at $227,065 was produced. In 1889, a total of 119 quarries produced granite, sandstone, and limestone, the entire output of stone being valued at $1,264,016. These comparisons speak for themselves in showing the great strides in the stone industry which have been made in the last decade in this State.

Granite.—The granite production of the State has been entirely confined to the past decade, no mention of granite in this State having been made in the Tenth Census report. The value of the granite in 1889 was $266,095 and represented the output from eight quarries scattered over Green Lake, Marinette, and Marquette counties. The product was distributed as follows: Green Lake, $154,645; Marinette, $79,950, and Marquette, $31,500. The great bulk of the product was used for street work in the manufacture of paving blocks. The total value of granite devoted to street work is $223,825. Of this amount $179,075 was the value of the paving blocks produced; $40,640 worth was used for building purposes and a comparatively very small amount for cemetery work. The marked advances made in the production of granite are emphatically shown by the statemant that this State stands in sixth place among the granite-producing States of the Union in the value of paving blocks produced. Most of the paving blocks came from Green Lake and Marquette counties, for which Milwaukee forms an important place of consumption.

Sandstone.—Thirty-two quarries, scattered over fourteen counties in the State, produced sandstone in 1889. The productive counties, in the order of importance, are as follows: Bayfield, $69,995; Pierce, $28,980; Douglas, $28,096; Ashland, $28,000; Dunn, $15,261, and smaller amounts from Sauk, Lafayette, Monroe, Portage, Jackson, Lacrosse, Trempealeau, Dane and Grant. Bayfield, Douglas and Ashland counties, in the northwestern extremity of the State, produced together $126,091 worth of stone. The remainder comes from the central, western, and southwestern parts of the State. Nearly the entire product was used for building purposes, a small amount being devoted to bridge and railroad work.

Limestone.—Seventy-nine quarries produced $813,963 worth of limestone and lime. The productive counties are as follows: Fond du Lac, $160,800; Calumet, $133,842; Milwaukee, $99,550; Waukesha, $98,020; Racine, $57,017; Ozaukee, $53,640; Dodge, $35,844; Manitowoc, $31,370; Winnebago, $27,120; Brown, $25,669; Washington, $25,358; Door, $20,254, and smaller amounts from Saint Croix, Lacrosse, Sheboygan, Rock, Walworth, Buffalo, Trempealeau, Outagamie, Jefferson, Portage, Dane, Grant, Iowa, Columbia, and Green. The first twelve counties produced $768,484 worth of the entire output. They are all in the southeastern part of the State, and Milwaukee is the most important outlet. Of the total value of limestone and lime $514,947 is the value of the lime produced. For building purposes an amount valued at $232,780 was used. Smaller amounts were devoted to street, bridge, and railroad work; and also for blast-furnace flux. The following analyses have been made:

Analysis of limestone from Calumet county, Wisconsin.

	Per cent.
Calcium carbonate	55.50
Magnesium carbonate	38.20
Alumina	2.27
Oxide of iron	.67
Silica	3.14
Total	99.78

Analysis of limestone from Winnebago county, Wisconsin.

[By Dr. John C. Jack.]

	Per cent.
Calcium carbonate	51.97
Magnesium carbonate	42.91
Iron	.18
Alumina	1.82
Silica	3.01
Total	99.89

Analysis of limestone from Brillion, Calumet county, Wisconsin.

	Per cent.
Carbonate of calcium	55.09
Carbonate of magnesium	43.96
Alumina	.36
Silica	.59
Total	100.00

This stone is used almost entirely for burning into lime, which appears to be very popular throughout the territory in which it is used.

WYOMING.

Sandstone.—Sandstone to the value of $16,760 was produced in the following counties, in the order of value: Laramie, Albany, Converse, Carbon and Sweetwater. The product was entirely used for building, and chiefly in Cheyenne.

Limestone.—In Laramie county a trifling amount of limestone was produced.

Marble.—A marble quarry has been discovered in Converse county. No output has yet been secured, but, according to the evidence so far, the stone is of a fair quality and efforts have been made to secure the investment of capital in the deposit, but as yet without success. The locality is seven miles from the nearest railroad.

POTTERY.

Owing to the large number of small potteries where the clay used is found on the spot and not purchased, it has been impracticable to determine the entire amount of clay used in pottery in the United States, except for the larger concerns. For these the statement given below for the years 1887 and 1888 are fairly accurate. But in the census investigation for the calendar year 1889 the scope was extended to all the clay for white ware burned in pottery kilns. The large result is not surprising, especially in view of the relatively low value assigned to the clay from the small potteries where rough stoneware and even unglazed pottery are the chief products. The results for 1890 are not obtained from a census, but from an inquiry as to the general condition of the industry among the large potteries. They are only offered to show this condition.

Amount and value of potters' materials from 1887 to 1890.

	1887.		1888.		1889.[a]		1890.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*	
Kaolin or china clay	22,000	$231,000	18,000	$189,000				
Ball clay	6,000	36,000	5,250	31,500	294,344	$635,578	350,000	$756,000
Fire clay	15,000	45,000	13,500	40,500				
Ground flint	19,800	168,000	16,250	138,125	11,113	49,137	13,000	57,400
Ground feldspar	10,200	112,200	8,700	95,700	6,970	39,370	8,000	45,200

[a] In 1889 and 1890 all clays burned in kilns are considered.

The pottery trade in 1888 was depressed compared with 1887, but nevertheless several new enterprises were started. In 1889 and 1890 fully the normal growth was obtained and the improvement in the grade of the product was especially pronounced. Nearly all the large potteries have extended their facilities for products of better designs and decorated in far better manner.

Among the new developments which add to the known stores of good potters' clay which have been mentioned in earlier reports, is the discovery of kaolin in Florida, near Lake Eustis. Dr. Francis Wyatt, of New York, has examined this clay for a company, and already tableware made from it is exhibited at nearby hotels. This is a different deposit from the clay found in the Florida phosphate region, which is more or less mixed with aluminum phosphate, and found as the matrix with bowlders of phosphate rock.

There are many new establishments begun in the last two years for working clays or marketing them for sale, especially in the Southern States. Near Chattanooga, Tennessee, five new and rather pretentious potteries have been established. Good white kaolin has also been found near Tullahoma. Other deposits have been found at Piney Flats, near London, near Smithville, and at Cookville, in Tennessee. In Georgia kaolin has lately been found at Atlanta, Buena Vista, Taylor, Augusta, and Milledgeville. Clays are being developed at Blacksburg, Florence, and Graniteville, South Carolina. In Virginia there are new potteries at Strasburg and Broadway, and clay deposits are being developed at Newport News, Murray, Harrisonburg, Staunton, and Williamsburg. In Kentucky pottery clay has been found at Rice's Station, near Red House, and the needed capital for its development has been supplied. In North Carolina two new companies are now established at Sylva. An unusually large bed of kaolin is reported at Kings mountain, and the works at Columbia, Dillsboro, and at Greensboro are to be enlarged. In Texas kaolin has been worked near Austin, and sedimentary clays are common in eastern Texas, particularly near Athens, in Henderson county; near Jefferson, Marion county, and Rusk, Cherokee county. The Geological Survey of Arkansas has called attention to large deposits of kaolin in Pulaski, Saline, Pike and Ouachita counties. One important bed examined in Ouachita county has a thickness of more than 12 feet. This bed outcrops in but few places, but it is probably several miles in length. Prof. Branner, the State geologist, says that the true nature of this material would hardly be suspected from its general appearance or analysis. As it comes from the ground it resembles a sandy clay. With the sand washed out it is found to have about the same composition as the kaolin from Brandywine Summit, Pennsylvania. The *Mining Industry*, of Denver, has called attention to some deposits of fine kaolin near Golden, Colorado. In California a large deposit of kaolin has been found near Grass Valley, and developments have begun on a large deposit near Oro Grande.

Imports and exports.—The following tables show the imports of various clay products and the extent to which this country supplies foreign demands.

Earthenware and china imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Years ending—	Brown earthen and common stone ware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen, stone, or crockery, glazed, etc.	Total.
June 30, 1867	$48, 618	$418, 493	$439, 824	$4, 280, 924	$5, 187, 859
1868	47, 208	309, 960	403, 555	3, 244, 958	4, 005, 712
1869	34, 260	400, 894	555, 425	3, 468, 970	4, 459, 549
1870	47, 457	420, 442	530, 805	3, 461, 524	4, 460, 228
1871	96, 695	391, 374	571, 032	3, 573, 254	4, 632, 355
1872	127, 346	470, 749	814, 134	3, 896, 664	5, 308, 893
1873	115, 258	479, 617	867, 206	4, 289, 868	5, 751, 944
1874	70, 544	397, 730	676, 656	3, 686, 794	4, 831, 724
1875	68, 501	436, 883	654, 965	3, 280, 867	4, 441, 216
1876	36, 744	409, 539	718, 156	2, 948, 517	4, 112, 956
1877	30, 403	326, 956	668, 514	2, 746, 186	3, 772, 059
1878	18, 714	289, 133	657, 485	3, 031, 393	3, 996, 725
1879	19, 868	296, 591	813, 850	2, 914, 567	4, 044, 876
1880	31, 504	334, 371	1, 188, 847	3, 945, 666	5, 500, 388
881	27, 586	321, 259	1, 621, 112	4, 413, 369	6, 383, 326
1882	36, 023	316, 811	2, 075, 708	4, 438, 237	6, 866, 779
1883	43, 864	368, 943	2, 587, 545	5, 685, 709	8, 686, 061
1884	50, 172	982, 499	2, 664, 231	666, 595	4, 363, 497
1885	44, 701	823, 334	2, 834, 718	963, 422	4, 666, 175
Dec. 31, 1886	37, 820	865, 446	3, 350, 145	951, 293	5, 204, 704
1887	43, 079	967, 694	3, 888, 509	1, 008, 360	5, 907, 642
1888	55, 558	1, 054, 854	4, 207, 598	886, 314	6, 204, 324
1889	48, 824	1, 148, 026	4, 580, 321	788, 391	6, 565, 562
1890	56, 730	974, 627	3, 562, 851	563, 568	5, 157, 776

Clay imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fireclay.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280. 25	$3, 113	....	....	6, 383. 75	$72, 204	$75, 317
1868	211. 00	2, 522	....	....	8, 383. 75	66, 958	69, 480
1869	324. 10	3, 587	....	....	12, 963. 75	84, 645	88, 232
1870	239. 40	2, 619	....	....	8, 014. 15	76, 057	78, 676
1871	290. 20	3, 383	....	....	10, 900. 48	103, 144	106, 527
1872	274. 00	3, 358	....	....	13, 081. 20	128, 130	131, 488
1873	251. 18	2, 978	1, 378. 30	$13, 091	12, 883. 82	141, 927	157, 996
1874	277. 20	3, 440	89. 21	1, 378	12, 909. 14	147, 782	152, 600
1875	300. 06	3, 694	130. 47	1, 977	10. 374. 65	116, 307	121, 978
1876	246. 73	3, 097	142. 00	2, 152	11, 799. 12	126, 738	131, 987
1877	400. 00	4, 460	204. 26	3, 009	11, 680. 14	129, 016	136, 485
1878	335. 07	4, 095	3, 499. 30	38, 899	9, 406. 74	95, 877	138, 871
1879	361. 21	4, 269	4, 774. 60	45, 272	8, 477. 80	87, 948	137, 489
1880	578. 00	6, 925	7, 823. 66	67, 740	11, 899. 80	117, 350	192, 015
1881	267. 55	3, 207	6, 867. 37	66, 654	12, 444. 28	123, 545	193, 406
1882	908. 27	11, 444	13, 954. 85	135, 448	12, 181. 39	119, 620	266, 512
1883	1, 241. 27	14, 309	12, 870. 60	115, 492	7, 841. 32	74, 673	204, 474

Classified imports of clay during the calendar years ending December 31 from 1885 to 1890.

Kinds.	1835.		1886.		1887.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	10, 626	$83, 722	16, 590	$123, 093	23, 486	$141, 360
All others:						
Unwrought	9, 736	76, 899	13, 740	113, 875	17, 645	139, 405
Wrought	3, 554	29, 839	1, 654	20, 730	2, 187	22, 287
Total	23, 916	190, 460	31, 984	257, 698	43, 318	303, 052

Classified imports of clay during the calendar years, etc.—**Continued.**

Kinds.	1888.		1889.		1890.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	18,150	$102,050	19,843	$113,538	29,923	$270,141
All others:						
Unwrought	20,604	152,694	19,237	145,983	21,049	155,486
Wrought	6,832	53,245	8,142	64,971	2,978	29,143
Total	45,586	807,989	47,222	824,492	53,950	454,770

Value of earthenware and stoneware of domestic manufacture exported from the United States from 1790 to 1890, inclusive.

Years ending—	Value.	Years ending—	Value.	Years ending—	Value.
Sept. 30, 1790	$1,990	June 30, 1847	$4,758	June 30, 1870	$42,120
1791	1,984	1848	8,512	1871	37,383
1826	1,958	1849	10,632	1872	48,941
1827	6,492	1850	15,644	1873	53,909
1828	5,595	1851	23,096	1874	59,494
1829	5,592	1852	18,310	1875	92,253
1830	2,773	1853	53,685	1876	73,846
1831	7,378	1854	33,867	1877	87,355
1832	6,333	1855	32,119	1878	98,035
1833	12,159	1856	66,696	1879	80,898
1834	12,745	1857	34,256	1880	106,724
1835	16,427	1858	36,783	1881	123,177
1836	13,391	1859	47,261	1882	180,773
1837	14,249	1860	65,086	1883	227,547
1838	12,019	1861	40,594	1884	236,247
1839	11,645	1862	32,108	1885	135,385
1840	10,959	1863	88,244	Dec. 31, 1886	203,699
1841	6,787	1864	67,591	1887	221,282
1842	7,618	1865	96,258	1888	138,502
June 30, 1843 (9 mos)	2,907	1866	81,616	1889	189,183
1844	4,884	1867	29,308	1890	157,821
1845	7,393	1868	29,528		
1846	6,521	1869	19,213		

Fire brick imported for consumption in the United States, 1884 to 1890, inclusive.

Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Number.
1884	1,524,000
1885	8,401,449
1886	4,904,675
1887	5,836,900
1888	6,093,491
1889	8,098,618
1890	6,206,856

PRECIOUS STONES.

BY GEORGE F. KUNZ.

During 1890 work was carried on at the tourmaline locality at Mount Mica, Paris, Maine. The work was more or less successful and over $2,000 worth of fine gems were obtained. For the first time in the history of America, turquois of fine color, in many respects equal to the Persian, was mined at the Castilian mine between Los Cerrillos and Santa Fé, New Mexico, of which over $10,000 worth was sold in 1890. These stones are well received by the gem trade, as the Persian mines have proved less and less prolific for many years past. Turquois has also been discovered in the Burro mountains, Grant county, New Mexico, and Saguache county, Colorado. Of especial interest among newer discoveries was the finding of a few crystals of diamond on Plum Creek, Pierce county, Wisconsin, where they were found in searching for gold under conditions almost identical with the finding of diamonds in North Carolina. The option was obtained on a tract of 4,000 acres on the Missouri River near Helena, Montana, for the purpose of mining sapphires. A preliminary examination made at the sapphire locality in Montana reveals the fact that sapphires exist in large quantities in the gold glacial gravels that lie immediately on the bed rock, a green slate. From present appearances extensive workings will be carried on for these fancy-colored stones, which are not true ruby red nor true sapphire blue. The success of the enterprise depends very much upon how many of these peculiar-colored gems the markets of the world will absorb.

As in former years, large quantities of garnets have been found in the vicinity of Gallup and Fort Wingate, New Mexico, and Fort Defiance, Arizona, whereas the search that is still being carried on at Ison's Mills, Elliott county, Kentucky, with the hope of finding diamonds there, has brought to light the fact that immense quantities of ruby red garnets—pyrope—exist in that vicinity.

With the exception of a single pebble of fire opal described in a former report, no true gem opal had been found in the United States. During 1890, however, near Whelan, southwest of Colfax, Washington, almost on the Idaho and Washington line, a brilliant fire and noble opal has been found filling the cavities of amygdaloidal basaltic rock, the cavities of which vary in size from that of a pea to a large walnut. Some of these opals have sold for almost the price of fine noble opals from Hungary.

Estimated production of precious stones

Species.	1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond		$800	$800			
Sapphire gems	$250	1,500	1,750		$500	$500
Chrysoberyl	25		25			
Topaz	200	300	500	$1,000	250	1,250
Beryl	300	400	700	250	500	750
Phenacite						
Emerald				3,000	200	3,200
Hiddenite				500	2,000	2,500
Tourmaline	1,500	500	2,000	500	100	600
Smoky quartz	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	3,000	4,000	200	2,500	2,700
Anthracite		2,500	2,500		2,500	2,500
Pyrite	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000		10,000	10,000		10,000
Arrow points	1,000		1,000		2,500	2,500
Trilobites	500		500		1,000	1,000
Sagenitic rutile	500	500	1,000		250	250
Hornblende in quartz	500	100	600		300	300
Thomsonite	250	500	750	250	500	750
Diopside				100		100
Agate	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500			
Turquoise	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500			
Sunstone	250	200	450	250	100	350
Fossil coral	500	250	750			
Rutile				750		750
Total	54,275	28,550	82,825	39,300	30,550	69,850
Gold quartz	40,000	100,000	140,000	40,000	100,000	140,000

in the United States from 1884 to 1888.

1886.			1887.			1888.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
....	$60	$60	....	....	....	....	....	....
$250	500	750	....	$500	$500	....	$500	$500
....	....	....	....	....	....	....	....	....
1,000	....	1,000	$1,500	500	2,000	$500	100	600
....	5,500	5,500	500	3,000	3,500	300	500	800
....	....	....	....	....	....	650	....	650
3,000	200	3,200	....	....	....	100	....	100
3,500	1,000	4,500	....	....	....	....	....	....
3,500	2,000	5.500	800	200	500	....	....	....
2,000	5,000	7,000	1,500	3.000	4,500	1,000	3,000	4,000
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,150	11,150
500	1,000	1,500	85,000	1,000	86,000	1,000	15,000	16,000
1,250	2,000	3,250	2,500	1,000	3,500	2,000	1,500	3,500
....	2,500	2.500	2,000	....	2,000	1,500	....	1,500
1,500	500	2,000	2,000	500	2,500	2,000	500	2,500
2,000	250	2,250	1,500	200	1,700	1,500	200	1,700
10,000	....	10,000	5,000	....	5,000	5,000	....	5,000
....	2,500	2,500	....	1,500	1,500	1,500	....	1,500
1,000	....	1,000	500	....	500	500	....	500
1,750	....	1,750	....	....	....	....	....	....
200	....	200	....	100	100	....	....	....
100	300	400	250	500	750	300	200	500
....	....	....	50	....	50	....	....	....
1,000	1,000	2,000	3,000	1,000	4,000	3,000	1,000	4,000
500	500	1,000	300	500	800	300	500	800
1,000	2.000	3,000	1,000	1,500	2,500	1,500	1,500	3,000
1,000	1,000	2,000	200	750	950	200	750	950
2,000	100	2,100	2,000	100	2,100	2,200	300	2,500
....	....	....	....	....	....	100	....	100
200	100	300	50	100	150	....	....	....
1,000	....	1,000	1.500	500	2,000	2,500	500	3,000
750	....	750	....	....	....	....	....	....
49,000	29,510	78,510	70,650	17,950	88,600	37,650	27,200	64,850
....	....	40,000	....	....	75,000	....	....	75,000

Production of precious stones, ornamental minerals, etc., in 1889 and 1890.

Names of gems or precious stones.	Value of stones before cutting.	Value of stones after cutting into gems for ornamental purposes.	Value of stones sold as specimens and curiosities, occasionally polished to beautify or show the structure.	Total value.
1889.				
Sapphire	$2,600	$6,725	....	$6,725
Emerald	....	300	$150	450
Aquamarine	225	597	150	747
Phenacite	....	....	200	200
Topaz	100	200	200	400
Turquoise	10,000	23,175	500	23,675
Tourmaline	1,030	2,250	....	2,250
Garnet	510	1,633	675	2,308
Quartz	510	2,750	11,250	14,000
Amethyst	15	98	....	98
Rose quartz	200	400	200	600
Smoky quartz	700	4,007	225	4,232
Gold quartz	6,000	9,000	....	9,000
Rutilated quartz	2	30	....	30
Dumortierite in quartz	....	....	250	250
Quartz coated with chalcedony	1,000	2,000	2,000	4,000
Chrysoprase	50	200	....	200
Agatized and jasperized wood	42,725	53,000	175	53,175
Banded and moss jasper	....	80	550	630
Amazon stone	....	....	500	500
Pyrite	100	500	1,500	2,000
Chlorastrolite	200	300	200	500
Thomsonite	100	200	200	400
Fluorite	....	....	500	500
Fossil coral	100	200	500	700
Azurite and malachite	1,000	....	2,037	2,037
Catlinite (pipestone)	....	....	5,000	5,000
Zircon (*a*)	....	....	16,000	16,000
Gadolinite, fergusonite, etc. (*a*)	....	....	1,500	1,500
Monazite (*a*)	....	....	1,000	1,000
Spodumene (*a*)	....	....	200	200
Wooden ornaments decorated with minerals (*b*)	....	....	15,500	15,500
Miscellaneous minerals (*c*)	....	....	20,000	20,000
Total	....	107,645	81,162	188,807
1890.				
Sapphire	$2,600	$6,725	....	$6,725
Emerald	....	....	....	....
Aquamarine	....	....	....	....
Phenacite	....	....	....	....
Topaz	....	....	....	....
Turquoise	10,000	28,175	$500	28,675
Tourmaline	1,030	2,250	....	2,250
Garnet	510	1,633	675	2,308
Quartz	510	2,750	11,250	14,000
Amethyst	....	....	....	....
Rose quartz	....	....	200	200
Smoky quartz	700	2,000	225	2,225
Gold quartz	6,000	9,000	....	9,000
Rutilated quartz	....	....	....	....
Dumortierite in quartz	....	....	250	250
Quartz coated with chalcedony	....	....	2,000	2,000
Chrysoprase	....	....	200	200
Agatized and jasperized wood	1,000	5,000	1,000	6,000
Banded and moss jasper	....	....	....	....
Amazon stone	....	....	500	500
Pyrite	100	500	1,500	2,000
Chlorastrolite	100	200	200	400
Thomsonite	100	200	200	400
Fluorite	....	....	500	500
Fossil coral	100	200	500	700
Azurite and malachite	....	....	....	....
Catlinite (pipestone)	....	....	5,000	5,000
Wooden ornaments decorated with minerals (*b*)	....	....	15,500	15,500
Miscellaneous minerals (*c*)	....	....	20,000	20,000
Total	....	58,633	60,200	118,833

a Used to extract the rarer elements for chemical purposes.
b Such as clocks, horseshoes, boxes, etc.
c For cabinets, museums, etc.

FERTILIZERS.

PHOSPHATE ROCK.

In 1889 more phosphate rock was produced in the United States than in any previous year—541,645 long tons in South Carolina, 4,100 long tons in Florida, and 500 tons in North Carolina. It was absorbed by the consumptive demand with no great accumulation of stocks by the producers. A larger amount than usual was exported, owing to low freights and good demand in England. In that country it probably displaced a corresponding amount of Belgian phosphates and reacted also on the lower grades of phosphate rock produced in England. Higher ocean freights and the hope that Florida phosphates would be mined in large quantities and at lower prices depressed the foreign demand for South Carolina river rock in 1890, and the total sales of South Carolina rock were reduced to 463,998 long tons, worth $2,875,605 in first hands at the place of shipment. In Florida the product in 1890 was 46,501 long tons, worth $338,190.

The phosphates of North Carolina have received little attention during the last two years, and one of the two establishments was burned out early in 1891. In Alabama the phosphate rock has only been used locally, and this is true also in Virginia, although an effort has been made to separate apatite from a phosphatic iron ore. Attention in the development of new deposits has been limited to Florida.

SOUTH CAROLINA.

As indicated above, the great product of 541,645 long tons, worth $2,892,276 in 1889 was followed by a decreased product of 463,998 long tons, worth $2,875,605 in 1890. This was due principally to failure to arrange European contracts. Further, important interests in river mining were concerned in a controversy with the State government in regard to the actual rights of phosphate miners, and this did not aid in keeping up the yield, which, however, was considerably greater than the product of 1888.

The following statement shows the annual product of phosphate rock in South Carolina since it became an industry. The figures for 1886, 1887, 1888, 1889 and 1890 are for calendar years; the previous years are trade years, ending May 31:

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1867	6	....	6
1868	12, 262	....	12, 262
1869	31, 958	....	31, 958
1870	63, 252	1, 989	65, 241
1871	56, 533	17, 655	74, 188
1872	36, 258	22, 502	58, 760
1873	33, 426	45, 777	79, 203
1874	51, 624	57, 716	109, 340
1875	54, 821	67, 969	122, 790
1876	50, 566	81, 912	132, 478
1877	36, 431	126, 569	163, 000
1878	112, 622	97, 700	210, 322
1879	100, 779	98, 586	199, 365
1880	125, 601	65, 162	190, 763
1881	142, 193	124, 541	266, 734
1882	191, 305	140, 772	332, 077
1883	219, 202	159, 178	378, 380
1884	250, 297	181, 482	431, 779
1885	225, 913	169, 490	395, 403
1885 (June 1 to December 31)	149, 400	128, 389	277, 789
1886 (calendar year)	253, 484	177, 065	430, 549
1887	261, 658	218, 900	480, 558
1888	290, 689	157, 878	448, 567
1889	329, 543	212, 102	541, 645
1890	353, 757	110, 241	463, 998

A good demand, particularly from the domestic trade, has kept the price good and the business in a remunerative condition, so that it can not be questioned that if attention had not been diverted to Florida most astonishing products must have come from South Carolina to supply the increased consumption.

A further item influencing the smaller product in 1890 was the increase in imported fertilizers in the previous year. In 1890, however, the imports declined again to the lowest amount and value in many years.

Phosphates imported and entered for consumption in the United States, 1868 to 1890, inclusive.

Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	99, 668	$1, 336, 761	....	$88, 864	$1, 425, 625
1869	13, 480	217, 004	....	61, 529	278, 533
1870	47, 747	1, 414, 872	....	90, 817	1, 505, 689
1871	94, 344	3, 313, 914	....	165, 703	3, 479, 617
1872	15, 279	423, 322	....	83, 342	506, 664
1873	6, 755	167, 711	....	218, 110	385, 821
1874	10, 767	261, 085	....	243, 467	504, 552
1875	23, 925	539, 808	....	212, 118	751, 926
1876	19, 384	710, 135	....	164, 849	874, 984
1877	25, 580	873, 459	....	195, 875	1, 069, 334
1878	23, 122	849, 607	....	285, 089	1, 134, 696
1879	17, 704	634, 546	....	223, 283	857, 829
1880	8, 619	108, 733	....	317, 068	425, 801
1881	23, 452	399, 552	....	918, 835	1, 318, 387
1882	46, 699	854, 463	133, 956	1, 437, 442	2, 291, 905
1883	25, 187	537, 080	96, 586	798, 116	1, 335, 196
1884	28, 090	588, 033	35, 119	406, 233	994, 266
1885	20, 934	393, 039	40, 068	611, 284	1, 004, 323
1886	13, 520	306, 584	82, 608	1, 179, 724	1, 486, 308
1887	10, 195	252, 265	53, 100	644, 301	896, 566
1888	7, 381	125, 112	36, 405	329, 013	454, 125
1889	15, 991	313, 956	35, 661	403, 205	717, 161
1890	4, 642	59, 580	31, 191	252, 787	312, 367

Guano brought from islands, rocks, and keys, appertaining to the United States, 1869 to 1890, inclusive.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Long tons.			*Long tons.*	
1869	15,622	$253,545	1880	12,795	$147,051
1870	14,318	356,830	1881	16,883	179,882
1871	14,154	340,295	1882	15,249	160,016
1872	4,209	60,865	1883	7,873	92,130
1873	11,014	161,690	1884	9,333	106,431
1874	6,877	100,345	1885	12,100	86,166
1875	7,209	122,012	1886	5,770	38,839
1876	14,785	192,972	1887	8,226	55,671
1877	6,060	79,822	1888	5,765	41,226
1878	17,930	211,239	1889	8,295	64,777
1879	8,733	95,137	1890	6,853	44,752

FLORIDA.

The report for 1888 announced the discovery of phosphate rock in Florida in large quantity, covering a great area, and rich in phosphoric acid. This rock is markedly different in character, and particularly in amount, from the small deposits which had been known for several years in this State. The discovery is of much more importance than all the other mineral resources of the State, and, indeed, this is certainly regarded as of more importance in the world's supply of fertilizing material than any other known deposit. Since the report in 1888 the deposits have been examined by representatives of practically all the phosphate mining regions of the world with a view to determining the influence of the new discovery upon phosphate mining elsewhere. So much had been written on the subject as to lead to great expectations of a large product immediately, especially as the mining problems are unusually simple. But the railroad facilities require great development in this rather new country, and numberless items necessary in preparing for a large and continuous product are seldom considered, especially by those at a distance. In England the consumers delayed their purchases in 1890 until the last moment in hopes of large Florida shipments and resultant low prices. The shipments which were made did affect the prices, although the quantity was not great. The material was in a condition new to the consumers and offering some new problems in its conversion to superphosphate. This gave the material a lower price than it deserved, and soon called a halt in reckless mining and shipping without profit. The cheap offset to bad mining afforded by a combination is under trial now, but the more intelligent development of the mines and lower costs everywhere is the ultimate solution.

In the report for 1888 a product of 3,000 long tons was noted. In 1889, 8,100 long tons were mined, and of this quantity 4,100 long tons went into use in that year. In 1890 the product developed satisfactorily and was fully in pace with the facilities afforded for getting the rock to the consumers. The sales amounted to 46,501 long tons worth, as shipped, $338,190—more than the total mineral product of the State in previous years.

The area in which phosphate rock has been found in the State has been increased each time it has been described, and at present it is very uncertain, and this particularly because of variations in quality, as the material shades out into limestone. Thus far the developments have been west of the longitudinal ridge of the State, although some beds of washed pebble rock have been found on the lower St. Johns river.

At the close of 1888 Mr. Albertus Voght, living near Dunnellon, a village on the Withlacoochee river, in Marion county, found fossil teeth in a white subsoil. Some of this white soil was submitted to a chemist for analysis and found to contain a large proportion of calcium phosphate—ordinary phosphate of lime. Active exploration began at once and extended rapidly with the speculative excitement usual to such discoveries. The fact is well established that much of the material is of unusually high grade—the highest in the United States. This developmental or rather speculative work was the main feature of the years 1889 and 1890, with more real development work in the latter.

Florida phosphates may be divided into four classes: (1) hard rock; (2) soft rock; (3) land pebble; and (4) river pebble. Of the hard-rock phosphate there are the following local variations: The massive rock itself; the laminated rock, in which there are narrow layers of phosphate separated by equally narrow interspaces, and the plate phosphate, which is probably derived from the laminated variety and is thus far found in only one or two localities in Florida in the more recent deposits. The hard-rock phosphate is white, creamy, and varies in texture and structure from one of homogeneous appearance to a brecciated variety, and to still others carrying considerable sand and clay. It is sometimes stained in a slight degree with iron, and always contains more or less alumina. The percentage of phosphate of lime contained in this class of phosphate rock is from 80 to 86. The hard-rock phosphate as thus far developed is from a point about south of Tallahassee, following the line of the Gulf at a distance of 20 to 30 miles around to below Dade City in peninsular Florida. Its length is a little less than 200 miles. This deposit is not continuous, but may occur at any point within this length. It also extends into the north of Florida quite to the Georgia line in the vicinity of the Suwannee river. The width of the belt is between 6 and 10 miles. Mining is by open pits, and will be conducted in the future with the most improved plants. The hard-rock phosphate consists of masses of bowlders piled together over large areas; the actual depth of any of these piles has not been determined, the greatest yet reached being about 60 feet from the surface. Hard-rock phosphate bowlders have been derived from rocks of two geological ages—the Eocene, which has the widest areal distribution, and the Miocene, which is found within the comparatively limited area southeast of Tallahassee. Phosphate has also been mined near Boston, Georgia, a station on the line of the Savannah, Florida and Western Railroad. In the vicinity of Dunnellon, where the hard-rock region is crossed by the Withlacoochee river; the phosphate has been broken down and is now dredged from the bottom of the stream in a form somewhat altered from its original condition, or as pebbles. Vertebrate remains occur in abundance.

The soft-rock phosphate occurs both as a deposit by itself and in the deposits of hard rock, filling the spaces between the bowlders. It may be either clayey or sandy in its nature. It falls considerably below the hard rock in the percentage of phosphate of lime, and naturally shows a higher percentage of alumina and iron.

The land-pebble phosphate is found in a number of localities in peninsular Florida, the center of production at present being in Polk county, within a radius of 18 miles of Bartow. Thus far it has been worked only to the west of the Peace river, within 12 or 15 miles of it, but prospectors have reported its occurrence beneath a large part of the surface between Peace river and the Gulf. It is essentially a mass of white phosphatic pebbles lying in a matrix of phosphatic clay or sand, usually a combination of the two. The matrix is easily disintegrated by water and the pebbles are washed out by appropriate machinery. The pebbles vary in size from grains to one inch in diameter, the average being between one-quarter and one-half an inch. They are hard, and usually pure white or cream colored on fresh fracture. The percentage of phosphate which they contain is about 75 to 80, but the yield of the rock as mined would not reach this standard. The land pebble is found in several parts of Florida, in the vicinity of Bartow, in connection with the plate rock at Anthony and Sparr, 10 miles north of Ocala, and again northeast of Gainesville, occupying an extensive area here. The age of the land-pebble deposits is probably older Pliocene. Land-pebble mining is developing rapidly; the most complete plant is that of the English company, seven miles south of Bartow, where, under favorable conditions existing, enormous basins have been dug, in which dredges of great capacity are floated. The pebble is dredged, washed by machinery adapted to this purpose, dried, and then shipped.

The river pebble is found in bars in the rivers of southern Florida the greatest production at present being from the Peace river, which furnishes nearly the entire product. The other rivers in southern Florida that are known to carry river pebble in quantity are the Alafia, the two Manatees, the Caloosahatchee; in northeast Florida, Black creek, a tributary to the Saint Johns, which enters the latter stream about 20 miles south of Jacksonville, also furnishes a small amount. Pebble phosphates are also found in many other streams entering the Gulf, but thus far not in workable quantities. With the pebbles the remains of vertebrate animals are often found. The river pebble is blue or black, from one inch down in size, usually finer as distance down the stream is gained. It occurs as pebbles, or more rarely as the hardened casts of small mollusks, which show some attrition by water. In the Caloosahatchee river the pebble is mixed with ordinary shells of carbonate of lime washed out from the Pliocene and Post-Pliocene beds bordering the river above. The derivation of the river pebble is probably very largely from the land pebble deposits, the streams in which they occur draining the country occupied by these deposits. Some of them may also have been derived from the hard rock phosphate. The percentage of phosphate of lime in the river pebbles is between 58 and 68, the average of the cargoes running between 60 and 65 per cent. The river pebble is dredged, washed, and floated on the river to the works, where it is dried, cleaned, and made ready for shipment. The phosphate drying works are very extensive.

The distribution of the phosphate deposits in Florida as they were known in 1889 and 1890 is well given in the volume, Mineral Industries in the United States, of the final reports of the Eleventh Census, which also shows quantitatively the number of enterprises engaged in developing the rock and their importance. In 1891, 215 companies had been formed for work in this field, and the number is constantly increasing.

Marl.—The production of marl in the United States during 1889, as determined by the Eleventh Census, was 139,522 tons, valued at $63,956. In 1890 there was a slight increase in the production, which is estimated at 153,620 tons, valued at $69,880. As heretofore, New Jersey produced nearly the entire amount, North Carolina and Arkansas contributing only about 1,500 tons. The producers of this substance in New Jersey are so numerous that exact statistics of production and value are almost impossible to obtain—certainly impossible with the means at command—as a large percentage of the farms in the marl belt, which extends from Raritan bay to near the mouth of the Delaware river, with an average width of about 15 miles, is underlaid with workable deposits of marl. The open winters of the past few years have tended to materially decrease the production of marl, owing to the difficulty of hauling during such seasons. By far the larger portion of marl is produced by farmers and sold to their neighbors or used on their own farms, which accounts for the difficulty of obtaining exact statistics on this subject, the producers very rarely keeping accurate accounts of the amount of marl used or sold.

Canadian apatite.—The product of apatite in Quebec and Ontario in the last few years has been determined by Mr. E. D. Ingall, of the Canadian Geological Survey, and is given below, together with the product since 1878. The greater part of the product came from Ottawa county, Quebec; here the producing mines are the North Star, of the Dominion Phosphate Company; the High Rock, owned by the Phosphate of Lime Company; the Star Hill and Crown Hill, of the Canadian Phosphate Company; the Emerald mine, of the Ottawa Company, and the Blackburn mine, in Templeton Township. In Ontario the output is largely the intermittent work of farmers, but there are regular plants at the Toxton, Ottly Lake, and Bob's Lake mines, and at those in North Burgess.

Although the higher grades of Canadian rock finds a very ready market in England, and receive 1 to 3 cents more per unit of phosphate than most other sorts, the trade was considerably disturbed by the Florida developments. This affected the price rather than the shipments.

Product of Canadian apatite from 1878 to 1890.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1878	3, 701	1885	24, 290
1879	11, 927	1886	20, 495
1880	7, 974	1887	23, 690
1881	15, 601	1888	22, 485
1882	17, 181	1889	30, 988
1883	17, 840	1890	31, 753
1884	22, 143		

BUHRSTONES.

Value of buhrstones produced in 1889, $35,155; value of buhrstones produced in 1890, $23,720. The domestic production of flint and quartz grit for the manufacture of buhrstones and millstones has shown a steady decrease since 1886. Grinders of paint, gypsum, and cement rock continue to use the domestic millstone to some extent, but its use in grinding cereals has been almost entirely abandoned for the more modern roller process. French buhr is still used in some flouring mills which have not adopted the roller process. The decreasing tendency of the industry may be seen from the following table, showing the annual production since 1883. The producing States in 1889 and 1890 were New York, Pennsylvania, and Virginia:

Value of buhrstones produced in the United States since 1883.

Years.	Value.
1883	$150,000
1884	150,000
1885	100,000
1886	140,000
1887	$100,000
1888	81,000
1889	35,155
1890	23,720

Value of buhrstones and millstones imported into the United States from 1868 to 1890.

Years ended—	Rough.	Made into millstones.	Total.
June 30, 1868	$74,224	....	$74,224
1869	57,942	$2,419	60,361
1870	58,601	2,297	60,898
1871	35,406	3,698	39,104
1872	69,062	5,967	75,029
1873	60,463	8,115	68,578
1874	36,540	43,170	79,710
1875	48,068	66,991	115,059
1876	37,759	46,328	84,087
1877	60,857	23,068	83,925
1878	87,679	1,928	89,607
1879	101,484	5,088	106,572
June 30, 1880	$120,441	$4,631	$125,072
1881	100,417	3,495	103,912
1882	103,287	747	104,034
1883	73,413	272	73,685
1884	45,837	263	46,100
1885	35,022	455	35,477
Dec. 31, 1886	29,273	662	29,935
1887	23,816	191	24,007
1888	36,523	705	37,228
1889	40,432	452	40,884
1890	32,892	1,103	33,995

CORUNDUM AND EMERY.

The total product of corundum and emery in 1889 was 2,245 short tons, valued at $105,565. In 1890 the product decreased somewhat, being 1,970 tons, worth at the mines $89,395. The States of Massachusetts, New York, North Carolina, and Georgia furnish the supply. A small quantity, about 5 tons, came from South Carolina. The value of corundum at the mines varies from $20 to $100 per ton, the best coming from the Georgia and North Carolina mines.

Production of corundum and emery for the years 1881 to 1890.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1881	500	$80,000	1886	645	116,190
1882	500	80,000	1887	600	108,000
1883	550	100,000	1888	589	91,620
1884	600	108,000	1889	2,245	105,567
1885	600	108,000	1890	1,970	89,395

Emery imported into the United States from 1867 to 1890, inclusive.

Years ended—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
June 30, 1867	....	....	428	$14,373	924,431	$38,131	....	$52,504
1868	....	....	85	4,531	834,286	33,549	....	38,080
1869	....	....	964	35,205	924,161	42,711	....	77,916
1870	....	....	742	25,335	644,080	29,531	....	54,866
1871	....	....	615	15,870	613,624	28,941	....	44,811
1872	....	....	1,641	41,321	804,977	36,103	....	77,424
1873	610,117	$29,706	755	26,065	343,828	15,041	$107	70,919
1874	331,580	16,216	1,281	43,886	69,890	2,167	97	62,366
1875	487,725	23,345	961	31,972	85,853	2,990	20	58,827
1876	385,246	18,999	1,395	40,027	77,382	2,533	94	61,653
1877	343,697	16,615	852	21,964	96,351	3,603	....	42,182
1878	334,291	16,359	1,475	38,454	65,068	1,754	34	56,601
1879	496,633	24,456	2,478	58,065	133,556	4,985	....	87,506
1880	411,340	20,066	3,400	76,481	223,855	9,202	145	105,894
1881	454,790	22,101	2,884	67,781	177,174	7,497	53	97,432
1882	520,214	25,314	2,765	69,432	117,008	3,708	241	98,695
1883	474,105	22,767	2,447	59,282	93,010	3,172	209	85,490
1884	143,267	5,802	4,145	121,719	513,161	21,181	188	148,890
1885	228,329	9,886	2,445	55,368	194,314	8,789	757	74,800
Dec. 31, 1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,638
1887	367,239	14,290	2,078	45,033	a144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287	....	....	8,743	118,246
1889	503,347	18,937	5,234	88,727	....	....	111,302	218,966
1890	534,968	20,382	3,867	97,939	....	....	5,046	123,367

a To June 30 only; since classed with grains.

GRINDSTONES.

The value of grindstones produced in the United States in 1889 was $439,587. In 1890 the value of the product increased to $450,000. To this production four States contributed, Ohio, Michigan, South Dakota and California, named in the order of importance. It is difficult, if not practically impossible, to separate the product of Ohio and Michigan, as many producers operate in both States and the manufacture of the finished stones is carried on principally at Cleveland, Ohio. These two States contribute about 98 per cent. of the entire product.

The following tables show the value of the grindstones produced in the United States since 1880 and the imports from 1868 to 1890.

Value of grindstones produced in the United States, 1880 to 1890, inclusive.

Years.	Value.	Years.	Value.
1880	$500,000	1886	$250,000
1881	500,000	1887	224,400
1882	700,000	1888	281,800
1883	600,000	1889	439,587
1884	570,000	1890	450,000
1885	500,000		

Grindstones imported and entered for consumption in the United States, 1868 to 1890, inclusive.

Years ended—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
June 30, 1868		$25,640		$35,215	$60,855
1869		15,878		99,715	115.593
1870		29,161		96,444	125,605
1871	385	43,781	3,957.15	60,935	104,716
1872	1,202	13,453	10,774.80	100,494	113,947
1873	1,437	17,033	8,376.84	94,900	111,933
1874	1,443	18,485	7,721.44	87,525	106,010
1875	1,373	17,642	7,656.17	90,172	107,814
1876	1,681	20,262	6,079.34	69,927	90,189
1877	1,245	18,546	4,979.75	58,575	77,121
1878	1,463	21,688	3,669.41	46,441	68,129
1879	1,603	24,904	4,584.16	52,343	77,247
1880	1,573	24,375	4,578.59	51,899	76,274
1881	2,064	30,288	5,044.71	56,840	87,128
1882	1,705	30,286	5,945.61	66,939	97,225
1883	1,755	28,055	6,945.63	77,797	105,852
1884					86,286
1885					50,579
Dec. 31, 1886					(*a*)39,149
1887					(*a*)50,312
1888					(*a*)51,755
1889					(*a*)57,720
1890					(*a*)45,115

a Classed as finished or unfinished.

INFUSORIAL EARTH.

The product in 1889 amounted to 3,466 short tons, valued at $23,372. In 1890 the product was 2,537 tons. Of this amount 2,532 tons were marketed, realizing $50,240. The difference in value as appearing between the products of 1889 and 1890 is not due to any notable rise in the price, but simply to the value being estimated at different stages of preparation. In California, for instance, the amount of crude earth produced was 39 tons, but this was sold only in the form of "Callustro" preparations, valued at $10,335. The mines at Dunkirk, Maryland, produced 1,500 tons and those of Pope's Creek 560 tons, with an aggregate value of $29,000. The remainder of the product was from Connecticut, Nevada, and New Hampshire. Thirty-five tons of earth carried over from production in previous years were marketed from New Jersey, but none was mined in that State during the year.

The production of infusorial earth in 1880, according to the Tenth Census, was 1,833 short tons, valued at $45,660, or about $25 per ton. The product for the subsequent years is shown in the following table. The figures for 1889 are from the Eleventh Census.

Production of infusorial earth from 1880 to 1890.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1880	1,833	$45,660	1886	1,200	$6,000
1881	1,000	10,000	1887	3,000	15,000
1882	1,000	8,000	1888	1,500	7,500
1883	1,000	5,000	1889	3,466	23,372
1884	1,000	5,000	1890	2,532	50,240
1885	1,000	5,000			

OILSTONES, WHETSTONES, ETC.

Total product in 1889, 2,991 short tons, valued at the quarries at $32,980.

The product in 1890 consisted of 761,348 pounds of Washita and Arkansas oilstone, valued at the quarries at $12,384; 15,000 gross of scythestones, valued at $46,000; 500,000 pounds of Hindostan and Orange stone, valued at $10,275; 2,000 pounds of Labrador oilstone, valued at $250, and 8,000 pounds of chocolate whetstones, valued at $1,000. The total value of the 1890 product, as above, was $69,909. In this the value is taken for the manufactured product, with the exception of the Arkansas and Washita oilstone. This is quarried in Arkansas, shipped in its rough state to New Hampshire, and there made into the oilstones of commerce. The difference in the value of the product in 1889 and 1890 is due to the fact that the value of the entire product of the former year was taken in the rough state. The producing States remain as heretofore noted, Arkansas, Indiana, New Hampshire, and Vermont.

Imports of whetstones and razor hones for the years 1880 to 1890.

Years ended—	Value.	Years ended—	Value.
June 30, 1880	$14,185	Dec. 31, 1886	$21,141
1881	16,631	1887	24,093
1882	27,882	1888	30,676
1883	30,178	1889	27,400
1884	26,513	1890	37,454
1885	21,434		

CEMENT.

Production.—The following table shows the product of the natural rock cements in the leading districts during the years named:

Product of natural cement in 1889, 1890, and 1891.

Localities.	1889.	1890.	1891.
	Barrels.	*Barrels.*	*Barrels.*
Rosendale, New York	2,547,225	2,683,579	2,815,010
Louisville, Kentucky	1,338,464	1,533,579	1,501,200
Buffalo and Akron, New York	682,275	698,396	745,450
Lehigh Valley, Pennsylvania	350,000	450,000	520,000
Milwaukee, Wisconsin	350,000	400,000	425,000
Utica and La Salle, Illinois	350,000	400,000	450,000
Potomac River	200,000	200,000	250,000
Fort Scott, Kansas	150,000	150,000	140,000
Mankato, Minnesota	78,912	87,650	101,875
Onondaga and Schobarie counties, New York	225,000	202,000	215,000
Virginia, Georgia, Texas, Ohio, Missouri, and New Mexico	270,000	277,000	288,000
Totals	6,531,876	7,082,204	7,451,535

The above statement was compiled at the close of the year 1891 by Mr. U. Cummings, who has collected statistics of this character for many years. In preparing a statement of the technical features involved in cement manufacture for the report to follow the present volume, Prof. Spencer B. Newbury has made an independent canvas of the entire country and the following table shows the results of this work. The wonderfully close agreement of the two statements is especially gratifying from the difficulty of securing returns with such remarkable promptness from scattered producers who are also engaged in very active competition. The agreement would be even more striking if the grouping of districts had been identical.

Product of hydraulic cement in the United States.

BY SPENCER B. NEWBURY.

	Works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
Georgia	1	40,000	$40,000	40,000	$40,000
Illinois, Utica and La Salle	2	363,117	292,784	409,877	276,931
Indiana and Kentucky (Louisville region)	11	1,533,579	1,150,184	1,513,009	983,456
Kansas and Missouri (Kansas City and Fort Scott)	2	175,000	122,500	135,000	94,000
Maryland, Hagerstown, Cumberland, and Hancock	3	223.209	203,785	204,900	187,855
Minnesota, Mankato	1	87,650	65,737	101,875	76.406
New York, Onandaga county	8	281,086	183,268	288,941	188,944
New York, Ulster county	17	2,683,579	2,213,982	2,815,010	2,252,008
New York, Schoharie county	1	25,357	20,286	27,055	21,644
New York, Buffalo and Akron	4	765,734	560,277	788,300	575,283
Ohio, Bellaire and New Lisbon	2	57,000	56,000	70.000	68,000
Pennsylvania (Lehigh Valley)	6	555,000	434,900	695,000	536,600
Tennessee, Chattanooga	1	48,423	43,540	33,100	36,026
Utah, Salt Lake City	1	....	....	5,000	10,000
Virginia and West Virginia	2	20,000	15,000	20,000	15,000
Wisconsin, Milwaukee	1	450,000	180,000	460,000	150,000
Total	63	7,308,734	5,582,243	7,607,067	5,512,153

Product of Portland cement in the United States in 1890 and 1831.

BY SPENCER B. NEW[illegible]

	Works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
California, San Diego	1	....	....	5,000	$15,000
Colorado, Denver	1	12,500	$40,000	12,500	40,000
Dakota, Yankton	1	....	....	31,813	71,579
Indiana, South Bend	1	15,000	36,000	15,000	36,000
New York, Onondaga county, Buffalo, etc	5	65,000	140,000	87,000	290,000
Ohio, Bellefontaine and Columbus	2	22,000	49,000	35,000	82,000
Pennsylvania, Lehigh and Lawrence counties	7	221,000	439,050	268,500	532,850
Total	18	335,500	704,050	454,813	1,067,429

Price.—The average price, considering all grades of natural rock cement, was 72 cents per barrel in 1889, 70 cents per barrel in 1890, and 68 cents per barrel in 1891. This is for cement in wood. The lower prices are due, to a considerable extent, to fierce competition in the West. Fully one-half of the cement sold at Buffalo, New York, and all points west of that, is in sacks. All cement sold in Buffalo and west of it is rated at 265 pounds to the barrel, all sold east of Buffalo contains 300 pounds to the barrel, and Portland cement is 380, so that there are three different weights for a barrel of cement in this country. The fact that Portland cement is frequently said to do better than the natural cement may be in many cases due to the fact that one-third more cement is given to the barrel.

Cement imported and entered for consumption in the United States, 1868 to 1890.

Years. (*a*)	Quantity.	Value.
	Barrels.	
1868	....	$10,168
1869	....	9,855
1870	....	18,057
1871	....	52,103
1872	....	172,839
1873	....	209,097
1874	....	286,429
1875	....	261,741
1876	....	247,200
1877	....	201,074
1878	....	184,086
1879	....	212,719
1880	....	$373,264
1881	....	441,512
1882	370,406	683,684
1883	456,418	802,294
1884	(*b*) 585,768	825,095
1885	554,396	874,070
1886	915,255	962,689
1887	1,514,095	1,470,846
1888	1,835,504	1,731,456
1889	1,740,356	1,704,253
1890	1,940,186	2,249,741

a Calendar years ending December 31 from 1886; previous years end June 30.

b Classed simply as cement; kind not specified since 1883. It is probable, however, that about 95 per cent of the total imports is Portland cement.

Lime and cement of domestic production exported from the United States, 1864 to 1890.

Years. (*a*)	Quantity.	Value.
	Barrels.	
1864	....	$86,386
1865	....	94,606
1870	31,175	61,490
1871	27,575	51,585
1872	39,686	69,218
1873	27,873	52,848
1874	41,349	69,080
1875	64,087	98,680
1876	53,827	77,568
1877	78,341	97,923
1878	82,507	98,334
1879	60,657	$74,097
1880	41,989	52,584
1881	57,555	83,598
1882	67,030	100,169
1883	74,687	120,156
1884	65,768	108,437
1885	79,627	127,523
1886	83,247	123,687
1887	63,520	97,771
1888	100,070	147,309
1889	89,995	142,298
1890	86,963	152,295

a Calendar years ending December 31 from 1886 to 1890; previous years end June 30.

New developments.—A new and important discovery of cement rock was made during 1890 in the coast range of mountains near Sierra Peak, about 3½ miles southwest of South Riverside, in southern California. It is owned and controlled by Messrs. Fraser Brothers of South Riverside, California.

It comprises about 330 acres in extent, and is fully 90 feet in thickness.

It lies in horizontal strata, the edges being exposed in a cañon passing through it. It is capped in most places by 3 to 5 feet of limestone. The deposit lies partly in Orange and partly in San Bernardino counties, the county line running north and south through its eastern portion.

A thorough examination of this deposit was made during the spring and summer of 1891 by a competent authority on cements, and it developed qualities as good as any known cement deposit; only trifling variation exists in the proportion of ingredients between the upper and lower layers, and a thorough admixture of the different layers, calcined and ground together, resulted in a cement showing the following analysis :

Composition of cement from South Riverside, California.

	Per cent.
Silica	24.34
Alumina	8.56
Lime	63.62
Magnesia	0.40
Oxide of iron	2.08
Alkalies	1.00
Total	100.00

The rock is blue-black in color, and is extremely fine grained, hard and compact, the fracture conchoidal.

A series of tests of the cement extending over a period of eight months exhibit no signs of shrinking, swelling, checking, or disintegration. It bears submersion immediately after being made up into balls, patties, or briquettes, and it neither heats nor falls down, and its induration is in perfect keeping with the laws governing the action of first quality hydraulic cements. Several experiments were made as to its Portland-making qualities, and it was found that a first quality of Portland cement can be produced without the admixture of any extraneous material whatever, as shown by the analysis.

The Portland experiments were made by grinding the various layers together in the raw state, then moistening sufficiently to press into balls or cakes, and exposing to a white heat until the point of incipient vitrifaction was reached, the clinker, after a gradual cooling, was reduced to powder and spread out in a thin layer for a week, and then made into briquettes and tested in the usual way—by tensile strain per square inch.

The following table is the average result of many tests:

Tests of South Riverside Portland cement.

Hours in air.	Days in water.	Breaking strength per square inch.
		Pounds.
1	1	135
1	7	280
1	30	475

The table following is the result of several hundred tests of the cement made after the manner of natural cements, by first calcining the rock, then reducing it to powder. All stages of calcination was resorted to from an under-burn up to the melting point, with a view to the development of imperfections, if any existed:

Tests of natural cement from South Riverside, California.

Hours in air.	Days in water.	Average breaking strength per square inch.	Hours in air.	Days in water.	Average breaking strength per square inch.
		Pounds.			*Pounds.*
1	1	115	1	28	291
1	7	178	1	90	354
1	14	223	1	210	485
1	21	256			

A bed of good bituminous coal about 7 feet thick probably underlies the entire cement rock deposits, as it is mined on both sides of the mountain range adjacent to the cement deposits, and it is probable that the coal can be reached at a reasonable depth by sinking a shaft in the cañon mentioned, and the shaft would undoubtedly pass through a bed of snowy gypsum of at least 40 feet in thickness, judging from the exposures on both sides of the narrow mountain.

No cement is produced in California, the entire supply coming from Europe, amounting in the aggregate to upwards of a million barrels during the year 1891.

Two or three attempts have been made to produce artificial Portland cement in that State, but the excessive cost has tended to a discontinuance of that industry. Therefore the discovery of this vast body of cement rock, containing upwards of 300,000,000 barrels of the raw material, from which a cement of most excellent quality can be produced at a very low cost, must prove of incalculable value to the people of that State, as it is located in the very heart of the famous orange belt, where the demand for cement for the construction of irrigation dams, canals, and pipe lines is already immense, yet increasing, and must continue to increase for many years to come.

A first-class cement plant capable of producing 1,200 barrels per day is projected and will probably be put in operation during the season of 1892 on the line of the Sante Fé railroad system at South Riverside, California, the rock to be brought down to the plant by a narrow-gauge system.

GYPSUM.

Total product in 1889, 267,769 short tons; value as first sold, $764,118. Total product in 1890, 182,995 short tons; value as first sold, $574,523.

The total amount of gypsum produced in the United States in 1890 was 84,774 short tons less than during 1889. The decrease in value was $189,595. Ninety per cent. of this loss will be covered by the decrease in Michigan and New York, the aggregate output in these two States alone being 76,595 tons less in 1890 than in 1889, and showing a total decrease in value of $188,024. The falling off in New York was due to the exceptionally wet weather which prevailed during the year. The entire product of the State is used as land plaster, which is most useful during a dry season. This assistance not being needed when plenty of rain has fallen, the production of gypsum decreases accordingly. The production in Michigan in 1889 was unusually large. One concern reporting a large output in that year produced no gypsum in 1890. The mill of Mr. Lorin Day, at Grandville, was burned May 19, 1890. The mill was rebuilt, but produced nothing more during the year (*a*).

An interesting feature of the gypsum-producing industry is the observation of the conditions in which it is marketed in the different producing localities. A limited amount is sold in the condition as mined. The sales in this particular in 1890 were limited to New York, Ohio, and Virginia. This portion of the product, though originally sold crude, is used as a fertilizer.

The distribution of the total product may be seen from a study of the following tables, showing the production in 1889 and 1890, by States:

Production of gypsum in 1889, by States.

States.	Amount produced.	Amount sold crude.	Value.	Amount sold as land plaster.	Value.	Amount of gypsum calcined into plaster of Paris or stucco.	Amount of plaster of Paris or stucco after calcining.	Value.	Total value.
	Short tons.	*Short tons.*		*Short tons.*		*Short tons.*	*Short tons.*		
California	3,000					3,000	2,250	$30,000	$30,000
Colorado	7,700			100	$140	7,600	4,325	28,800	28,940
Iowa	21,784			14,434	23,000	7,350	5,507	32,250	55,250
Kansas	17,332					17,332	[b]13,896	94,235	94,235
Michigan	131,767	35,100	$35,100	54,084	123,143	42,583	32,434	215,497	373,740
New York	52,608	21,537	21,642	31,071	57,834				79,476
Ohio	9,920	106	212	2,744	9,604	7,070	5,656	41,675	51,491
South Dakota	320					320	253	2,650	2,650
Utah	[c]16,000	16,000	25,000						25,000
Virginia	6,838	500	750	6,338	19,586				20,336
Wyoming	[d]500					500	390	3,000	3,000
Total	267,769	73,243	82,704	108,771	233,307	85,755	64,711	448,107	764,118

[a] Mr. Lorin Day's new mill was burned May 13, 1891.

[b] Of the Kansas product 600 tons were made into fireproof cement, producing 400 tons of cement, valued at $6,000.

[c] Estimated, and value given for crude material.

[d] Began operations November 1, 1889.

Production of gypsum in 1890, by States.

States.	Total amount produced.	Amount sold, crude.	Value.	Amount ground into land plaster.	Value.	Amount calcined (weight before calcining).	Value (after calcining).	Stocks Jan. 1, 1891.	Total value.
	Short tons.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Colorado	4, 580	....	....	50	$125	4, 530	$21, 925	....	$22, 050
Iowa	20, 900	....	....	2, 900	2, 350	18, 000	45, 000	....	47, 350
Kansas	20, 250	....	....	80	215	19, 420	72, 242	750	72, 457
Michigan	74, 877	15, 000	$15, 000	12, 714	28, 980	47, 163	148, 119	....	192, 099
New York	32, 903	3, 072	2, 858	29, 831	70, 235	....	....	....	73, 093
South Dakota	2, 900	....	....	2 900	7, 750	....	....	....	7, 750
Virginia	6, 350	100	150	4, 948	20, 632	....	....	1, 302	20, 782
Other States *a*	20, 235	570	1, 140	3, 102	12, 727	16, 563	125, 075	....	138, 942
Total	182, 995	18, 742	19, 148	56, 525	143, 014	105, 676	412, 361	2, 052	574, 523

a Ohio, California, and Wyoming.

In addition to the two States named, in which the product for 1890 was much less than in 1889, there was a decreased output in Colorado, Iowa, Utah and Virginia (*a*). The States showing increased production were California, Kansas (*a*), South Dakota and Wyoming. The following table is arranged to show the total amount and value of gypsum produced in each State for both years, with increases and decreases in 1890:

Comparative statistics of gypsum production for two years.

States.	Total product.		Increase.	Decrease.	Total value.		Increase.	Decrease.
	1889.	1890.			1889.	1890.		
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Colorado	7, 700	4, 580	....	3, 120	$28, 940	$22, 050	....	$6, 890
Iowa	21, 789	20, 900	....	884	55, 250	47, 350	....	7, 900
Kansas	17, 332	20, 250	2, 918	....	94, 235	72, 457	....	21, 778
Michigan	131, 767	74. 877	....	56, 890	373, 740	192, 099	....	181, 641
New York	52, 608	32, 903	....	19, 705	79, 476	73, 093	....	6, 383
South Dakota	320	2, 900	2, 580	....	2, 650	7, 750	$5, 100	....
Virginia	6, 838	6, 350	....	488	20, 336	20, 782	446	....
Other States (*b*)	29, 420	20, 235	....	9, 185	109, 491	138, 942	29, 451	....
Total	267, 769	182, 995	....	*c*84, 774	764, 118	574, 523	....	*c*189, 595

a Kansas has an increased product and decreased value. Virginia decreased product and increased value.

b Includes California, Ohio, Utah, and Wyoming.

c Net decreases.

The following table, showing the annual product of land plaster and stucco in Michigan, is taken from the annual report of Mr. Charles D. Lawton, commissioner of mineral statistics:

Amount of land plaster and stucco produced in Michigan.

Years.	Land plaster. (Short tons.)	Stucco.' (Barrels of 300 pounds.)	Years.	Land plaster. (Short tons.)	Stucco. (Barrels of 300 pounds.)
Previous to 1866	100,000	....	1878	40,000	48,346
1866	14,604	....	1879	43,658	50,800
1867	17,439	....	1880	49,570	106,004
Previous to 1868	....	*a*80,000	1881	33,178	112,813
1868	28,837	34,966	1882	37,821	135,165
1869	29,996	41,187	1883	33,227	201,133
1870	31,437	46,179	1884	27,888	156,677
1871	41,126	48,685	1885	28,184	141,575
1872	43,536	59,767	1886	29,378	153,274
1873	44,972	82,453	1887	28,794	170,107
1874	39,126	82,449	1888	22,177	196,698
1875	27,019	61,120	1889	19,823	206,080
1876	*a*39,131	64,386	1890	29,500	238,700
1877	*a*40,000	*a*55,000			

a Partly estimated.

Gypsum imported into the United States from 1867 to 1890.

Years ended—	Total.	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.
		Quantity.	Value.	Quantity.	Value.	
		Long tons.		*Long tons.*		
June 30, 1867	$125,281	....	$29,895	97,951	$95,386	....
1868	114,350	....	33,988	87,694	80,362	....
1869	186,512	....	52,238	137,039	133,430	$844
1870	148,720	....	46,872	107,237	100,416	1,432
1871	154,013	....	64,465	100,400	88,256	1,292
1872	168,873	....	66,418	95,339	99,902	2,553
1873	165,459	....	35,628	118,926	122,495	7,336
1874	170,901	....	36,410	123,717	130,172	4,319
1875	171,096	....	52,155	93,772	115,664	3,277
1876	179,070	....	47,588	139,713	127,084	4,398
1877	162,917	....	49,445	97,656	105,629	7,843
1878	140,587	....	33,496	89,239	100,102	6,989
1879	125,542	....	18,339	96,963	99,027	8,176
1880	150,409	....	17,074	120,327	120,642	12,693
1881	171,724	....	24,915	128,607	128,107	18,702
1882	200,922	5,737	53,478	128,382	127,067	20,377
1883	218,969	4,291	44,118	157,851	152,982	(*a*) 21,869
1884	210,904	4,996	42,904	166,310	168,000	....
1885	173,752	6,418	54,208	117,161	119,544	....
1886	153,338	5,911	37,642	122,270	115,696	....
1887	195,890	4,814	33,736	146,708	162,154	....
Dec. 31, 1888	190,787	3,340	20,764	156,697	170,023	....
1889	220,140	5,466	40,291	170,965	179,849	....
1890	229,859	7,568	55,250	171,289	174,609	....

a Not specified since 1883.

FLUORSPAR.

The only locality producing fluorspar continues to be at Rosiclaire, Illinois. The product in 1889 was 9,500 short tons, valued at \$45,835. In 1890 there was a decrease in production, the product being 8,250 short tons, but an advance in the price increased the value to \$55,328. The following table exhibits the annual production of this mineral since 1882:

Production of fluorspar in the United States from 1882 to 1890.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	4,000	\$20,000	1887	5,000	\$20,000
1883	4,000	20,000	1888	6,000	30,000
1884	4,000	20,000	1889	9,500	45,835
1885	5,000	22,500	1890	8,250	55,328
1886	5,000	22,000			

Regarding the reintroduction of fluorspar for metallurgical uses, Dr. Foehr, of Germany, has contributed the following to the Chemiker Zeitung:

"Fluorspar was considered an indispensable flux until the commencement of this century; it diminishes the loss of metal and was then the only energetic means of reducing the melting point of slag from ores carrying a high percentage of clay and zinc. Without fluorspar very refractory ores could not be smelted at all.

"Gradually, however, as the blast furnaces and smelting apparatus were improved, fluorspar was superseded by lime and other cheap fluxes, but of late its use has been reintroduced into nearly all branches of metallurgy.

"While fluorspar is regarded merely as a material to unite with excessive silicic acid, the possibility of its adoption is surprising in view of the fact that the cost of fluorspar is six to seven times greater than that of limestone while the reactions of fluorspar and limestone, respectively,

$$2CaF_2 + 3SiO_2 = 2CaSiO_3 + SiF_4 \text{ and}$$
$$3CaCO_3 + 3SiO_2 = 3CaSiO_3 + 3CO_2$$

show that the quantitative economy in fluxing with fluorspar compared with limestone is as 156 to 300. The fact is, however, that one part of fluorspar goes further than ten parts of limestone. The former is specially effective in reducing the quantity of fuel; it forms two parts of slag where limestone forms three, and it forms possibly also fluorsilicate, whereby heat is likely to be liberated.

"While the rather high price of fluorspar prevents its use in the production of ordinary white and gray pig iron, it has proved a rapid and energetic solvent in blast-furnace work, where it is blown in as powder through the nozzles.

"In making silicon iron, fluorspar plays a more important part. A ferro-silicon iron, with 10 per cent. silicon, made specially in Upper Silesia, is almost indispensable for works that make very tough, deep gray castings. This ferro-silicon can be obtained in any ordinary blast furnace from any siliceous iron ore if it is only fluxed with fluorspar and the slag is strongly basic. The fluorspar reduces the silicon energetically; at all events, fluorsilicon is formed which is reduced to silicon by the hydrogen contained in the furnace gases, and possibly also directly by the coke. It does not seem impossible that the greatly increased price for coke will result in a reintroduction of fluorspar as a fuel-saving flux in the manufacture of foundry pig, particularly as even a very small quantity of fluorspar added to the charge at once raises the product to No. 1 deep gray pig, rich in graphite.

"The remarkable property of fluorspar, that it facilitates the reduction of the most different bodies—a property common to almost all the fluorides—makes it a valuable flux in the production of spiegeleisen. It has long been known that fluoride of manganese, as well as a mixture of a manganese combination with fluorspar, can comparatively easily be reduced to metallic manganese by means of sodium. This reaction served Brunner in his successful attempts, the first ever made, to produce metallic manganese in large quantities. The modern application of this method to the blast furnace substitutes carbon for sodium. A highly basic slag, rich in fluorides, seems nearly indispensable for the production of a rich ferro-manganese in the blast furnace.

"The property of fluorspar of carrying phosphorus into the basic slag has never been of special importance as far as pig iron is concerned, but it is utilized by the Krupp & Rollet methods of dephosphorizing pig in the basic-lined cupola furnace. While, at all events in the blast furnace process, the property of calcium fluoride of forming an easily melting slag with phosphates is of some importance, fluorspar in the process of purifying the pig iron serves probably only as a flux for the highly basic lime slag saturated with phosphorus.

"In the Thomas process too, and even in the Bessemer converter, fluorspar is in recent practice being added in small quantities for the purpose of concentrating the slag and reducing the loss of metal; very great care, however, is needed to prevent such a slag from attacking the acid lining. It is also said that in puddling in the various steel-making methods and in the Siemens-Martin process fluorspar is added partly as a slag-forming flux. The details are, however, not known.

"In foundry work, it is an astonishing fact that limestone, which, because of its cheapness, superseded fluorspar, of late is losing ground to the latter. The limestone flux in cupola-furnace work serves only to slag the ashes of the fuel, the sand adhering to the pig, etc., no chemical effect on the iron being intended. But fluorspar affects the iron noticeably, keeps it gray and soft by keeping the silicon as an alloy, while a limestone flux favors the tendency of the silicon to slag. Besides, fluorspar carries some phosphorus and sulphur into the slag. Fluorspar makes it possible to melt inferior pig iron and a higher percentage of scrap. But, strange enough, practice has shown that too much fluorspar is rather injurious than advantageous; one reason for this being that the manganese contained in the iron is thereby prevented from slagging.

"The quantity of fluorspar which is added to 100 kilograms of pig iron to be remelted is one-third or at the most one-half, kilogram. The improvement of the product caused by this flux is specially manifest in the improved cupola furnaces, particularly the Herbert furnace, which has much facilitated the utilization of inferior iron for soft castings. The property of fluorspar to protect manganese does not seem favorable enough to offset the injury due to its silicon-reducing power. Its use would, at least, require melting in a basic furnace or as cold as possible.

"As the small quantity of the phosphorus and sulphur which is contained in Swedish charcoal iron is almost entirely carried off in the comparatively acid slag by fluorspar, this is of prominent importance for the treatment of very pure qualities of iron.

"Fluorspar was formerly the most important flux for smelting copper ores in the German stack, as well as in the English reverberatory furnace. The Mansfeld copper slate, for instance, was fluxed with up to 10 per cent. of fluorspar, the cost of this being about 8 per cent. of the total smelting cost. The effect of this flux depended essentially on the volatilization of fluorsilicon, whereby the strongly acid slag was reduced in silica. The introduction of improved and heated blasts in the Mansfeld works has almost confined the use of fluorspar to the blowing in of furnaces. Five per cent. of fluorspar is commonly added at the start, but the quantity decreases gradually until after from two to five weeks no fluorspar at all is used. The English reverberatory furnace process fluxed formerly with as much as 10 per cent. of fluorspar, but nowadays this takes place only with ores rather rich in arsenic. Fluoride of calcium with arsenides of metals gives very volatile fluoride of arsenic, which, with a reducing flame, easily escapes. The risk of loss involved in the volatile fluoride of copper necessitates the presence of excessive carbon whenever fluorspar is employed in the metallurgy of copper.

"While fluorspar is at present of small value in the treatment of copper ores containing sulphur, its property of giving very fluid combinations with gypsum and barytes may prove an important means for working poor oxides and siliceous ores as well as charges containing azurite, malachite, red oxide of copper, atacamite and earthy red oxide of copper, by reducing the smaller part of the sulphate and forming a matte very rich in copper, and by forcing its larger part together with the fluoride of calcium into the slag which thereby becomes thin and very fluid. Equal quantities of fluorspar with gypsum or barytes produce the most fluid slag. A significant point particularly with poor ores high in silica is that this slag is poor in copper—a fact on which was based the former Freiberg practice of resmelting the copper slag, together with pyrites and fluorspar, thus obtaining copper matte and poor slag, the intention probably being to enrich the matte in copper and impoverish it in iron.

"Fluxing copper ores containing nickel with fluorspar is very favorable for the collection of the nickle in the matte, and has been in use in the Riechelsdorf, Grünthal and Mansfeld works. The chemical process is still entirely obscure and worthy of study in the laboratory. Possibly nickel arsenide is decomposed into volatile fluoride of arsenic and nickel, which latter goes into the matte. Fluorspar is an almost indispensable flux for making tough copper and, generally, whenever silicon, which makes copper highly brittle, has to be removed. As a means of producing a matte poor in iron in the reverberatory furnace, a mixture of fluorspar, barytes, and quartz is more energetic and rapid than an addition of only the two last named, the proportion of the fluorspar and the barytes being for this purpose as between 1 and 3, whilst the quantity of quartz depends upon how much iron the roasted matte contains. Too much fluorspar gives a matte rich in iron. For refining and resmelting copper, fluorspar finds a constantly increasing use. Mixed with some soda it is most excellent in resmelting copper ingots and for removing from the metal bath small quantities of arsenic and silicon. The process is kept a secret; the refining slag is, however, reported to be resmelted with gypsum or glauber salts and fluorspar.

"The introduction of the Pilz and Raschette furnace has made lead and silver smelting without fluorspar a possibility. It is too expensive for this purpose, except for particularly refractory ores; but it has proved most excellent for fluxing ores containing barytes and zinc. Possibly the temperature of the slag formation is reduced, thus diminishing the quantity of metal that is lost through volatilization. This is of greater importance in the reverberatory than in the stack furnace, so that the use of fluorspar might occasion a special modification of the English reverberatory furnace process, a Derby process, with a flux of about 7 per cent. fluorspar. For resmelting lead slags also, a small fluorspar flux is serviceable. It is used, too, for smelting on the Spanish slag hearth.

"As in improved lead works the ores to be smelted are almost invariably first roasted; the fluorspar is added at the roasting. The quantity varies from 1 to 5 per cent. according to the percentage of the quartz in the ores. One per cent. of fluorspar, if ground as finely as possible, causes a noticeable economy in fuel. As this flux lowers the temperature in a roasting furnace and shortens the roasting process, the yield of metal must also be favorably affected.

"In refining, also, fluorspar is very advantageous, especially when sprinkled on the bath in a fine powder. The litharge is thereby made thinner and retains fewer metallic grains mechanically. The same effect is reached by adding a small quantity of soda, or mixture of soda and fluorspar.

"The slags from tin ores are generally very acid in the stack as well as in the reverberatory furnace. As it is particularly desirable here to reduce the quantity of slag as much as possible, fluorspar, which has this property and in addition makes the slag fluid, has long ago found use, especially in English tin works, where it sometimes forms 5 per cent. of the charge. Commonly, burnt limestone and fluorspar are mixed, although it seems far preferable to employ soda than lime. The fluorspar fluxing must not be too liberal, as otherwise the furnace walls are attacked and tin seems then to go into the slag.

"Fluorspar with zinc ores is very undesirable, as it attacks the distilling vessels. On the other hand, in order to overcome this obstacle, a material composed of pure quartz sand with about 3 per cent. fluorspar and some soda, has tentatively been used for tubes and muffles, which though apt to frit on the surface in annealing, become, on the escape of fluorspar, far more dense and fireproof than otherwise can be obtained. In fact a small quantity of fluorspar is regularly used in any considerable factory making fireproof ware. The ordinary zinc-distilling vessels are said to be extraordinarily improved by a glaze baking consisting of sulphate of zinc and fluorspar in equal quantities, in regard to product as well as the durability of the muffles. In refining pig zinc the remelting is sometimes facilitated by adding a mixture of glauber salt, rock salt, and fluorspar.

"When the price is not too high, fluorspar is an advantageous means of fluxing garnierite, but still more important in the concentration of speiss.

"Fluorspar has been recommended for regenerating brittle silicon platinum, by keeping the platinum in powdered fluorspar incandescent and cemented long enough to enable the total amount of silicon to escape as a fluoride. It appears, however, more rational to substitute ammonium fluoride for fluorspar, the price being immaterial because of the small quantity used.

"It would be a worthy object for scientific ambition to study the physical properties of fluorspar experimentally smelted together with oxides of metals, ores, and metal salts, with or without fluxes of silicates and sulphates, and in different proportions, specially if the range of the investigation were extended to the conduct of metal fluorides and silicon by incandescence in oxidizing and reducing atmosphere."

Cryolite.—The only source of supply remains at Ivigtok, Greenland. The importations since 1871 have been as follows:

Imports of cryolite for the years 1871 to 1890, inclusive.

Years ended—	Amount.	Value.	Years ended—	Amount.	Value.
	Long tons.			*Long tons.*	
June 30, 1871	....	$71,058	June 30, 1881	....	$103,529
1872	....	75,195	1882	3,758	51,589
1873	....	84,226	1883	6,508	97,400
1874	....	28,118	1884	7,390	106,029
1875	....	70,472	Dec. 31, 1885	8,275	110,750
1876	....	103,530	1886	8,280	110,152
1877	....	126,692	1887	10,328	138,068
1878	....	105,884	1888	7,388	98,830
1879	....	66,042	1889	8,603	115,158
1880	....	91,366	1890	7,129	95,405

MICA.

The product of mica in 1889 was 49,500 pounds, valued at $50,000 at the mines in the condition in which it was first sold. In addition to this, 196 short tons of scrap or waste mica were sold for grinding purposes, with a value of $2,450. The industry, as it plainly shows, has declined rapidly. In 1890 there were signs of improvement. The product aggregated 60,000 pounds, worth $75,000 at the mines. The scrap mica sold for grinding increased also to 300 tons.

Increased interest in mica properties was evident during 1890. There were some sales of mines in North Carolina, and a company of greater capacity than usual was organized as the Western Carolina Mica Company. The modern apparatus which they have introduced bids well for a much greater yield in the future.

Cut mica produced in the United States from 1880 to 1890.

Years.	Amount.	Value.	Years.	Amount.	Value.
	Pounds.			*Pounds.*	
1880	81,669	$127,825	1886	40,000	$70,000
1881	100,000	250,000	1887	70,000	142,250
1882	100,000	250,000	1888	48,000	70,000
1883	114,000	285,000	1889	49,500	50,000
1884	147,410	368,525	1890	60,000	75,000
1885	92,000	161,000			

The States producing mica in 1889 were New Hampshire, North Carolina, Virginia, and South Dakota. Only one mine in Virginia, at Amelia Court House, was productive, and that was discontinued early in 1889. The mines in the West, where labor is higher, naturally felt the decline in prices most severely, and hence the New Mexican development at Cerrillos was discontinued in 1888, and in the Black Hills only one mine remained in 1889 out of eleven in 1884. The occurrence of good mica has been determined in Wyoming and Washington, but the owners have not yet developed the mines. This is not surprising when the valuation for the mines determined by the Eleventh Census aggregates $691,550 and the returns for the year 1889 show a net loss for the entire industry.

The most encouraging outlook for the industry is in connection with the increasing use for the scrap mica, which accumulates in about the proportion of 10 pounds of waste to 1 of cut sheets, even when the cut sheets take in the smaller sizes now used for stoves. By mills located in Denver, Richmond, New York, and Boston a large proportion of this is now ground and used for making lubricants, for insulators, and in wall paper.

Imports.—In October, 1890, mica was placed on the dutiable list by the new tariff, with a duty of 35 per cent. ad valorem. It had previously been imported free. The imports for the year, especially before the law went into effect, were exceptionally heavy—more than double the value of the imports in any previous year. This undoubtedly provides for an accumulation of stock beyond immediate needs.

Unmanufactured mica imported and entered for consumption in the United States, 1869 to 1890, inclusive.

Years ending—	Value.	Years ending—	Value.
June 30, 1869	$1,165	June 30, 1880	$12,562
1870	226	1881	5,839
1871	1,460	1882	5,175
1872	1,002	1883	9,884
1873	498	1884	28,284
1874	1,204	1885	28,685
1875	....	Dec. 31, 1886	[a]56,354
1876	569	1887	[a]49,085
1877	13,085	1888	[a]57,541
1878	7,930	1889	[a]97,351
1879	9,274	1890	[a]207,375

[a] Including mica waste.

SOAPSTONE.

Total product in 1889, 12,715 short tons; value, $231,708. Total product in 1890, 13,670 short tons; value, $252,309.

The amount of soapstone produced in the United States in 1889 (exclusive of the output of fibrous talc at Gouverneur, New York), was 12,715 short tons, valued at $231,708. The value here quoted represents the aggregate amount received by operators for their product in the condition in which first marketed, whether rough, manufactured, or pulverized. In some cases the mineral is sold without further preparation than being sawed into slabs convenient for shipping. In other cases, it is manufactured at the quarries into various useful articles for mercantile, domestic, or scientific purposes, or pulverized for use in the manufacture of soap, paint, paper, and rubber, and in such instances the only value obtainable is for the manufactured product. Following the same line of computation in the investigation for 1890, the product was 13,670 short tons, valued in its first selling condition at $252,309.

Fibrous talc.—The fibrous variety of soapstone obtained at Gouverneur, New York, is especially valuable as a filler in the manufacture of medium grades of paper. The product in 1889 was 23,746 short tons, valued at $244,170. In 1890 the product increased to 41,354 tons, valued at $389,196. Of the product in 1890, 10,350 tons were sold in the crude state as mined, and the remainder, 24,459 tons, sold ground ready for use. Mr. Frank C. Goodall, in a paper read before the Institute of Naval Architects records his experience that a paint with soapstone as the mineral ingredient serves unusually well for protecting metallic ship bottoms, and that similar paint has been used for many years in China and Japan.

Talc imported into the United States from 1880 to 1890, inclusive.

Years.	Quantity (pounds).	Value.	Years.	Quantity (pounds).	Value.
1880		$22,807	1886		$24,514
1881		7,331	1887	(a)	49,250
1882		25,641	1888	24,165	22,446
1883		14,607	1889	19,229	30,993
1884		41,165	1890	1,044	1,560
1885		24,356			

[a] Quantity not reported previous to 1888.

ASPHALTUM.

BY E. W. PARKER.

The production of asphaltum and its allied mineral, bituminous rock, in 1889 was limited to California, Kentucky, and Utah. The commercial product in 1890 was also confined to these localities. Ohio produced 600 tons, but the product was not marketed during the year and is not considered in the total. The varieties, qualities, and values of the several bitumens are so widely different that they might readily be classed as separate minerals. In fact, a new name is usually given to each new discovery. In this manner the names of gilsonite, elaterite, uintite, wurtzilite, albertite, grahamite, and a number of others have been bestowed. The latest discovery has been honored with the name of "lithocarbon." It is found a few hundred miles west of San Antonio, Texas, near the line of the Southern Pacific Railroad. This has been thought by some to be an entirely new mineral, and great claims have been made regarding its possibilities. What is most strenuously claimed for it, and seemingly with some reason, is that it serves unusually well as the foundation for a paint or varnish for covering metallic surfaces. Thin metal covered with a coating of this varnish may be bent and twisted repeatedly without perceptible crack to the covering and without appearance of peeling off. A company has been organized in New York which claims to have obtained possession of several thousand acres of land on which the new mineral occurs, but with the exception of capitalizing the company no steps have been taken toward developing the property. Nor has it been possible to ascertain the extent of the deposit, and the probable effect its development will have industrially. There can be little doubt, however, that it is like the others, a species of asphaltum. It is found as a fossil limestone impregnated with bitumen, yielding upon refining a good quality of asphaltum which dissolves in turpentine to form varnish. This when dry does not crystallize, but remaining soft and pliable, and possessing strong adhesive qualities will doubtless serve the principal purpose claimed for it. Two unknown quantities must, however, be determined—the amount of available mineral and the cost of production and transportation.

The bituminous rock of California occurs in four different counties—Ventura, Santa Cruz, Santa Barbara, and San Luis Obispo. The product of Ventura county is of higher grade than any of the others; that is, it carries a larger percentage of bitumen. The product of the other three counties is used almost exclusively for street paving, it being necessary only to heat the mineral and thoroughly mix the ingredients before spreading. The average price of the product of Santa Cruz and San Luis Obispo counties is from $2 to $2.50 per ton. The Santa Barbara product is a grade between this and the Ventura county mineral, and is worth about $4 per ton. The Ventura rock is valued at from $10.50 to $12 per ton. Some of this is used for street paving, in the preparation of which it is necessary to mix the natural product, while heated with the sand of the locality where used. A considerable saving in transportation expenses is effected by this means. A considerable part of the Ventura product is refined, and used for a covering for piling, wharf timbers, wood conduits, etc., which it renders practically indestructible by protecting them from the action of air, water, insects, and other destructive agents.

The bituminous rock of Kentucky is not essentially different from the product of Santa Cruz and San Luis Obispo counties in California. It is worth about $2.50 per ton at the mines, which are in Grayson and Hardin counties, and is used for street paving, cellar, warehouse, and brewery flooring, and similar purposes.

The product of Utah consists of bituminous rock worth about $7.50 at the mines and of "gilsonite," an exceptionally pure form of asphaltum. Gilsonite contains about 90 per cent. pure bitumen. It is used for making street paving by mixing when heated with petroleum, sand, and limestone; for paint and varnish by dissolving in turpentine, and as an insulator for electrical wires. Gilsonite is valued at from $50 to $60 per ton at St. Louis, its point of distribution.

The following table shows the annual production of asphaltum and bituminous rock since 1882. Previous to 1888 the output was entirely from California and was consumed in street paving in the large cities. The industry can hardly be considered as having assumed commercial importance until 1888, and in the same year began the production of gilsonite in Utah.

Production of asphaltum and bituminous rock since 1882.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1882	3,000	$10,500	1887	4,000	$16,000
1883	3,000	10,500	1888	50,450	187,500
1884	3,000	10,500	1889	51,735	171,537
1885	3,000	10,500	1890	40,841	190,416
1886	3,500	14,000			

The increased value of the product of 1890 as compared with that of 1889 is due to a decreased production of bituminous rock in California and a largely increased output of gilsonite in Utah.

Trinidad asphaltum.—Notwithstanding the large proportions which the asphaltum and bituminous rock industry has attained in the West, the bulk of the supply for the United States, in fact nearly all that is consumed in the Eastern cities, continues to be procured from the island of Trinidad. This is due to the excessive cost of transportation from our Western localities. The European demand is supplied from the bituminous limestone deposits of Neufchatel, Switzerland, and Seyssel, France. A limited amount of Neufchatel asphaltum is imported into the United States. The following table shows the imports of asphaltum from 1867 to 1890, inclusive:

Asphaltum imported into the United States from 1867 to 1890.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Short tons.			*Short tons.*	
June 30, 1867	....	$6,268	June 30, 1879	8,084	$39,635
1868	185	5,632	1880	11,830	87,889
1869	203	10,559	1881	12,883	95,410
1870	488	18,072	1882	15,015	102,698
1871	1,301	14,760	1883	33,116	149,999
1872	1,474	35,533	1884	36,078	145,571
1873	2,314	38,298	Dec. 31, 1885	18,407	88,087
1874	1,183	17,710	1886	32,565	106,528
1875	1,171	26,006	1887	30.808	95,735
1876	807	23,818	1888	36,494	84,045
1877	4,532	36,550	1889	61,952	138,163
1878	5,476	35,932	1890	73,861	223,368

Capt. F. V. Greene, of New York City, vice-president of the Barber Asphalt Company, contributed some very interesting information to the census report on asphaltum from Trinidad and other foreign sources. As the figures and statements given by Captain Greene cover also the calendar year 1890, the following is abstracted from his contribution. Some of the information is obtained from the books of his company. Other portions are estimates which, while not derived from positive records, may be considered substantially correct:

Imports of Trinidad asphaltum by all companies from 1880 to 1890, inclusive.

Years.	Long tons.	Years.	Long tons.
1880	3,913	1887	26,593
1881	6,707	1888	35,137
1882	14,263	1889	52,881
1883	23,309	1890	54,692
1884	19,630		
1885	15,289	Total	280,171
1886	27,757		

Pavements of Trinidad asphaltum.—The number of square yards of Trinidad asphaltum laid in the United States in the past decade is as follows:

Number of square yards of Trinidad asphalt paving laid in the United States from 1880 to 1890, inclusive.

Years.	Sq. yards.	Years.	Sq. yards.
1880	106,838	1887	799,335
1881	116,629	1888	757,101
1882	196,184	1889	1,130,863
1883	387,510	1890	1,857,000
1884	424,524		
1885	403,882	Total	[a]6,803,054
1886	623,188		

[a] Equivalent to 446 miles of roadway 26 feet wide.

Trinidad asphaltum is being used for street paving in the forty-nine cities in the United States and Canada named in the following list:

Cities where Trinidad asphalt pavements are used.

Washington and Georgetown, D. C.
Savannah, Georgia.
Chicago, Illinois.
Fort Wayne and Indianapolis, Indiana.
Topeka, Wichita, and Wyandotte, Kansas.
Louisville, Kentucky.
New Orleans, Louisiana.
Baltimore, Maryland.
Boston, Massachusetts.
Detroit, Michigan.
Saint Paul, Minnesota.
Kansas City, Saint Joseph, and Saint Louis, Missouri.
Omaha, Nebraska.
Newark, New Jersey.
Albany, Binghampton, Brooklyn, Buffalo, Lockport, Long Island City, New York, Rochester, Schenectady, Syracuse, Troy, and Utica, New York.
Cincinnati, Cleveland, Columbus, Toledo, and Youngstown, Ohio.
Allegheny, Altoona, Erie, Harrisburg, Philadelphia, Pittsburg, Scranton, and Wilkesbarre, Pennsylvania.
Chattanooga, Tennessee.
Montreal, Quebec, and Toronto, Canada.

Percentage of uses for Trinidad asphaltum.—From the best information obtainable the proportions of Trinidad asphaltum used for different purposes are about as follows:

Proportions of uses of Trinidad asphaltum.

	Per cent.
For laying sheet asphalt pavements	72
For manufacturing asphalt blocks and tiles for pavements	24
Total for paving	96
For roofing	3
For all other purposes	1
Total	100

The amount of asphalt blocks manufactured and laid as pavements has varied from 5,000 to 100,000 square yards per annum, and the total from 1880 to 1890, inclusive, is estimated at 500,000 square yards.

Pavements from bituminous limestone.—About 55,000 square yards of bituminous limestone pavements were laid in Washington, D. C., during 1876 and 1877, and about 3,000 square yards in New York in 1883 or 1884. Nearly all of this was subsequently taken up and replaced by Trinidad asphaltum. In 1887 about 10,000 square yards were laid in Rochester, New York; in 1888 about 20,000 square yards in Saint Augustine, Florida, and in 1890, 40,000 square yards in New York City. Captain Greene estimates that the total amount of bituminous limestone pavement now in use in the United States does not exceed 75,000 square yards.

Asphalt pavements in European cities.—The asphalt pavements in Europe are all made from the bituminous limestones obtained from the localities mentioned previously in this report. The pavements are found in Berlin, London, Paris, and a few other cities, probably not exceeding ten in all. The total area covered is, approximately, as follows, according to the authorities cited, and it is about one-fourth of that covered by Trinidad asphalt pavements in the United States.

Areas of bituminous limestone pavements in use in European cities.

	Square yards.	Authorities.
Berlin	681,486	United States Consular Reports, No. 120.
London	360,000	Reports of paving companies.
Paris	357,360	Annuaire Statistique de la Ville de Paris, 1888, page 26.
Other cities	300,000	Estimated.
Total	1,698,846	

Ozocerite.—The amount of refined ozocerite or mineral wax produced in the United States in 1889 was 50,000 pounds, valued at $2,500 at the mines. In 1890 the product increased to 350,000 pounds. The value at the mines was about the same per pound as in 1889. The price quoted during the year was 7½ cents per pound at New York. The locality from which this product is obtained is near Thistle, Utah. It was discovered in 1885, but no work of any importance was done upon the property until 1888, when 65,000 pounds of crude mineral were mined. The principal supply of mineral wax is from Galicia, in Austria. This property was discovered in 1859. It was not until 1865, however, that sufficient capital could be obtained to push the enterprise. Now about thirty-five companies are in the field.

Imports of mineral wax. (*a*)

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1873	25,135	$4,244	June 30, 1882	272,509	29,322
1874	380	40	1883	565,658	52,774
1875	7,430	1,026	1884	617,992	69,026
1876	16,525	2,229	1885	1,056,438	123,976
1877	101,604	11,720	Dec. 31, 1886	800,496	71,220
1878	69,884	7,870	1887	718,769	59,084
1879	44,963	6,016	1888	1,164,940	89,131
1880	103,973	14,057	1889	1,078,725	86,682
1881	98,911	12,792	1890	1,669,241	142,333

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a Up to and including 1883 imported under "Wax and manufactures of," and classed as "bay or myrtle, Brazilian and Chinese," since as "Mineral wax."

SALT.

By William A. Raborg.

The production of salt in the United States during the years 1889 and 1890 was as follows: In 1889, 8,005,565 barrels, valued at $4,195,412, and in 1890, 8,776,991 barrels, valued at $4,752,286. The amount and value of the salt produced in the various States and Territories in the latter year, 1890, is given in the following table:

Quantity and value of salt produced in the United States during the year 1890.

States and Territories.	Production.	Value.
	Barrels.	
Michigan	3,837,632	$2,302,579
New York	2,532,036	1,266,018
Ohio	231,303	136,617
West Virginia	229,938	134,688
Louisiana	273.553	182,000
California	62,363	57,085
Utah	427,500	126,100
Kansas	882,666	897,199
Nevada, Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	300,000	200,000
Total	8,776,991	4,752,286

Comparative table of production of salt in States and Territories during years 1883 to 1890.

States and Territories.	1883.		1884.		1885.		1886.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*		*Barrels.*	
Michigan	2,894,672	$2,344,684	3,161,806	$2,392,536	3,297,403	$2,967,663	3,677,257	$2,426,989
New York	1,619,486	680,638	1,788,454	705,978	2,804,787	874,258	2,431,563	1,243,721
Ohio	350,000	231,000	320,000	201,600	306,847	199,450	400,000	260,000
West Virginia	320,000	211,000	310,000	195,000	223.184	145,070	250,000	162,500
Louisiana	265,215	141,125	223,964	125,677	299,271	139,911	299,691	108,372
California	214,286	150,000	178,571	120,000	221,428	160,000	214,285	150,000
Utah	107,143	100,000	114,285	80,000	107,140	75,000	164,285	100,000
Nevada	21,429	15,000	17,857	12,500	28,593	20,000	30,000	21,000
Kansas	....	....	....	....	....	....	....	....
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (a)	400,000	377,595	400,000	364,443	250,000	243,993	240,000	352,763
Total	6,192,281	4,251,042	6,514,937	4,197,734	7,038,653	4,825,345	7,707,081	4,825,345

a Estimated.

Comparative table of production of salt in States and Territories during years 1883 to 1890—Continued.

States and Territories.	1887.		1888.		1889.		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*		*Barrels.*	
Michigan	3,944,309	$2,291,842	3,866,228	$2,261,743	3,856,929	$2,088,909	3,837,632	$2,302,579
New York	2,353,560	936,894	2,318,483	1,130,409	2,273,007	1,136,503	2,532,036	1,266,018
Ohio	365,000	219,000	380,000	247,000	250,000	162,500	231,303	136,617
West Virginia	225,000	135,000	220,000	143,000	200,000	130,000	229,938	134,688
Louisiana	341,093	118,735	394,385	134,652	325,629	152,000	273,553	132,000
California	200,000	140,000	220,000	92,400	150,000	63,000	62,363	57,085
Utah	325,000	102,375	151,785	32,000	200,000	60,000	427,500	126,100
Nevada	....	....	....	....	....	....	....	....
Kansas	....	....	155,000	189,000	450,000	202,500	882,666	397,199
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (*a*)	250,000	150,000	350,000	143,999	300,000	200,000	300,000	200,000
Total	8,003,962	4,093,846	8,055,881	4,374,203	8,005,565	4,195,412	8,776,991	4,752,286

a Estimated.

MICHIGAN

With a production of 3,837,632 barrels of salt, valued at $2,302,579, Michigan headed the list of salt-producing States and Territories in 1890. In 1889 the production was 3,856,929 barrels, valued at $2,088,909. Since 1887 there has been a yearly decrease in the production, although the amount of salt made continued to represent over one-half the product of the United States.

The average depths of the wells in the different counties were as follows: Mason, 2,200 feet; Manistee, 2,000 feet; Saint Clair, 1,700 feet; Huron, 1,200 feet; Midland, 1,200 feet; Bay, Saginaw, and Iosco, 850 feet.

During 1890 there were 122 salt-producing companies in the State, 97 of which were in operation, having a capacity of production of 5,950,000 barrels.

Product of Michigan salt in 1890, by districts.

Counties.	Fine.	Bulk.	Fine packers'.	Packers'.	Solar.	Second quality.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Saginaw	655,293	305,127	308	1,659	18,896	25,571	1,006,854
Bay	581,072	214,787	462	3,138	....	20,644	820,103
Manistee	826,293	84,527	3,716	12,691	....	79,298	1,006,525
Mason	333,871	16,013	2,270	....	....	15,463	367,617
Huron	32,676	22,968	....	37	....	....	55,681
St. Clair	155,754	81,123	1,619	2,812	....	703	242,011
Iosco	289,232	....	....	....	....	....	289,232
Midland	46,812	1,353	55	....	....	1,389	49,609
Total	2,921,003	725,898	8,430	20,337	18,896	143,068	3,837,632

Grades of salt produced in Michigan as reported by the inspectors from 1869 to 1890, inclusive.

Years.	Fine.	Packers'.	Solar.	Second quality.	Common coarse.	Total for each year.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1869	513, 989	12, 918	15, 264	19, 117	....	561, 288
1870	568, 326	17, 869	15, 507	19, 650	....	621, 352
1871	655, 923	14, 677	37, 645	19, 930	....	728, 175
1872	672, 034	11, 110	21, 461	19, 876	....	724, 481
1873	746, 702	23, 671	32, 267	20, 706	....	823, 346
1874	960, 757	20, 090	29, 391	16, 741	....	1, 026, 979
1875	1, 027, 886	10, 233	24, 336	19, 410	....	1, 081, 865
1876	1, 402, 410	14, 233	24, 418	21, 668	....	1, 462, 729
1877	1, 590, 841	20, 389	22, 949	26, 818	....	1, 660, 997
1878	1, 770, 361	19, 367	33, 541	32, 615	....	1, 855, 884
1879	1, 997, 350	15, 641	18, 020	27, 029	....	2, 058, 040
1880	2, 598, 037	16, 691	22, 237	48, 623	....	2, 685, 588
1881	2, 673, 910	13, 885	9, 683	52, 821	....	2, 750, 299
1882	2, 928, 542	17, 208	31, 335	60, 222	....	3, 037, 307
1883	2, 828, 987	15, 424	16, 735	33, 526	....	2, 894, 672
1884	3, 087, 033	19, 308	16, 957	38, 508	....	3, 161, 806
1885	3, 230, 646	15, 480	19, 849	31, 428	....	3, 297, 403
1886	3, 548, 731	22, 221	31, 177	71, 235	3, 893	3, 677, 257
1887	3, 819, 738	19, 385	13, 903	73, 905	17, 378	3, 944, 309
1888	3, 720, 319	18, 126	26, 174	87, 694	13, 915	3, 866, 228
1889	3, 721, 099	19, 780	17, 617	93, 455	4, 978	3, 856, 929
1890	3, 655, 331	20, 337	18, 896	143, 068	....	3, 837, 632

NEW YORK.

Of the 2,532,036 barrels of salt, valued at $1,266,018, which is given as the production of the State of New York during 1890, 1,546,412 barrels were made in the Onondaga reservation and 985,624 barrels in the Warsaw district. An annual decrease in the production of the Onondaga district has occurred each year since 1882, when the amount of salt made was nearly double that of 1890, while the product of the Warsaw district in 1890 was very nearly 13 times as great as that of 1883.

Product of salt in New York for the years 1883 to 1890.

	1883.	1884.	1885.	1886.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	7, 497, 431	6, 942, 270	6, 934, 299	6, 101, 757
Warsaw district	600, 000	2, 000, 000	4, 589, 635	6, 056, 060
Total	8, 097, 431	8, 942, 270	11, 523, 934	12, 157, 817

	1887.	1888.	1889.	1890.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	5, 695, 797	5, 657, 367	5, 365, 089	4, 928, 122
Warsaw district	6, 072, 000	5, 935, 000	6, 000, 000	7, 732, 060
Total	11, 767, 797	11, 592, 367	11, 365, 089	12, 660, 182

Salt inspected at the Onondaga wells in 1889 and 1890.

Districts.	Solar.		Fine ground.		Ground solar.		Ground dairy.	
	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Syracuse	841,042	837,807	647,698	637,539	146,938	142,734	77,773	44,495
Salina	163,200	138,803	629,035	537,783				
Liverpool	756,760	688,133	142,947	142,965				
Geddes	1,008,987	918,994	832,046	714,458			118,618	124,411
Total	2,769,989	2,583,737	2,251,726	2,032,745	146,938	142,734	196,391	168,906

Production of the Onondaga district, 1797 to 1890, inclusive.

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797		25,474	25,474	1844	332,418	3,671,134	4,003,552
1798		59,928	59,928	1845	353,455	3,408,903	3,762,358
1799		42,704	42,704	1846	331,705	3,507,146	3,838,851
1800		50,000	50,000	1847	262,879	3,688,476	3,951,355
1801		62,000	62,000	1848	342,497	4,394,629	4,737,126
1802		75,000	75,000	1849	377,735	4,705,834	5,083,569
1803		90,000	90,000	1850	374,732	3,894,187	4,268,919
1804		100,000	100,000	1851	378,967	4,235,150	4,614,117
1805		154,071	154,071	1852	633,595	4,288,938	4,922,533
1806		122,577	122,577	1853	577,947	4,826,577	5,404,524
1807		175,448	175,448	1854	734,474	5,068,873	5,803,347
1808		319,618	319,618	1855	498,124	5,584,761	6,082,885
1809		128,282	128,282	1856	709,391	5,257,419	5,966,810
1810		450,000	450,000	1857	481,280	3,830,846	4,312,126
1811		200,000	200,000	1858	1,514,554	5,518,665	7,033,219
1812		221,011	221,011	1859	1,345,022	5,549,250	6,894,272
1813		226,000	226,000	1860	1,462,565	4,130,682	5,593,247
1814		295,000	295,000	1861	1,884,697	5,315,694	7,200,391
1815		322,058	322,058	1862	1,983,022	7,070,852	9,053,874
1816		348,665	348,665	1863	1,437,656	6,504,727	7,942,383
1817		408,665	408,665	1864	1,971,122	5,407,712	7,378,834
1818		406,540	406,540	1865	1,886,760	4,499,170	6,385,930
1819		548,374	548,374	1866	1,978,183	5,180,320	7,158,503
1820		458,329	458,329	1867	2,271,892	5,323,673	7,595,565
1821		526,049	526,049	1868	2,027,490	6,639,126	8,666,616
1822		481,562	481,562	1869	1,857,942	6,804,295	8,662,237
1823		726,988	726,988	1870	2,487,691	6,260,422	8,748,113
1824		816,634	816,634	1871	2,464,464	5,910,492	8,374,956
1825		757,203	757,203	1872	1,882,604	6,048,321	7,930,925
1826		811,023	811,023	1873	1,691,359	5,768,998	7,460,357
1827		983,410	983,410	1874	1,667,368	4,361,932	6,029,300
1828		1,160,888	1,160,888	1875	2,655,955	4,523,491	7,179,446
1829		1,129,280	1,129,280	1876	2,308,679	3,083,998	5,392,677
1830		1,435,446	1,435,446	1877	2,525,335	3,902,648	6,427,983
1831		1,514,037	1,514,037	1878	2,788,754	4,387,443	7,176,197
1832		1,652,985	1,652,985	1879	2,957,744	5,364,418	8,322,162
1833		1,838,646	1,838,646	1880	2,516,485	5,482,265	7,998,750
1834		1,943,252	1,943,252	1881	3,011,461	4,905,775	7,917,236
1835		1,209,867	1,209,867	1882	3,032,447	5,307,733	8,340,180
1836		1,912,858	1,912,858	1883	2,444,374	5,053,057	7,497,431
1837		2,167,287	2,167,287	1884	2,353,860	4,588,410	6,942,270
1838		2,575,033	2,575,033	1885	2,439,332	4,494,967	6,934,299
1839		2,864,718	2,864,718	1886	2,772,348	3,329,409	6,101,757
1840		2,622,305	2,622,305	1887	3,118,974	2,576,823	5,695,797
1841	220,247	3,120,520	3,340,767	1888	3,115,314	2,542,053	5,657,367
1842	163,021	2,128,882	2,291,903	1889	2,916,922	2,448,117	5,365,039
1843	318,105	2,809,395	3,127,500	1890	2,726,471	2,201,651	4,928,122

Average strength of Onondaga brines.

Years.	Syracuse.	Salina.	Liverpool.	Geddes.	Average.
1865	66.17	66.47	60.65	66.17	64.86
1866	65.90	65.81	58.34	65.90	63.98
1867	64.44	64.35	64.35	63.95	64.27
1869	60.96	60.86	60.36	59.02	60.18
1870	59.49	58.94	58.94	59.34	59.17
1871	63.00	62.35	62.35	63.82	62.88
1872	65.10	66.00	67.00	66.20	66.07
1873	63.43	65.33	65.43	67.52	65.43
1874	63.80	66.15	66.15	67.15	65.81
1875	63.88	66.38	66.38	69.50	66.54
1876	66.75	67.70	67.70	69.33	67.87
1877	68.94	69.19	69.19	69.59	69.23
1878	69.93	70.58	70.58	70.02	70.27
1879	66.61	67.47	67.47	67.16	67.17
1880	66.13	67.10	67.10	67.56	66.97
1881	67.02	66.68	66.68	68.21	67.14
1882	67.75	67.24	67.24	68.63	67.71
1883	66.67	68.30	68.30	69.34	68.15
1884	67.88	71.58	71.58	70.10	70.28
1885	67.63	70.99	70.99	69.25	69.72
1886	68.27	73.84	73.84	72.46	72.10
1887	67.30	70.77	70.77	72.20	70.26
1888	67.91	69.95	69.95	72.41	70.05
1889	67.03	69.28	69.28	71.93	69.38
1890	67.43	71.05	71.05	72.42	70.49

Production of salt in the Warsaw district, New York, in 1890.

Subdistricts.	Bushels.
Warsaw	5,000,000
Mount Morris	700,000
Silver Springs	586,040
Le Roy	500,000
Piffard	700,000
Castile	246,020
Total	7,732,060

The Tully Rock Salt and Brine Supply.—The town of Tully, in which is situated the rock salt deposit which furnishes the Solvay Process Company with its brine, is situated in the southern portion of Onondaga county. It is bounded on the south by Cortland county, on the east by the town of Fabius, on the north by the town of Lafayette, and on the west by the towns of Otisco and Spafford. Its southern portion, with the village of the same name and three lakes (though a fourth lake is on the same plateau, but in Cortland county), is surrounded by hills of considerable size and extent. The artificial outlet of Crooked lake formed the beginning of Onondaga creek and is at present used by the Solvay Process Company to furnish the fresh water for dissolving the rock salt in their wells. The Tully lakes are some 800 feet above Syracuse, while the twenty-one wells are about 300 feet below these lakes, so that the water from the lakes not only furnish the solvent of the rock salt but also the power by which the saturated brine is forced to the surface and into a reservoir from whence it runs by gravity to Syracuse. This advantage can not be overestimated, since it does away with the daily expense of pumping the brine and all that pertains to the latter operation.

The first well which was sunk in this locality is situated at a point near the center of the valley, when descending from the Tully Hills, near the cross road between the western and eastern portion of the valley. This well had to be abandoned at about 400 feet depth, since the tube collapsed after passing into quicksand. The next well was sunk 1,400 feet east of the former. It was started in the shales of the Hamilton group, through which it passed for 713 feet, then entering the limestones of the Helderberg group and continuing in the same for about 498 feet, when a bed of rock salt was penetrated for about 45 feet, making the total depth of the well 1,261 feet. The dip of the rock, as ascertained in these borings is 40.7 feet per mile from north to south, while the ground rises from the north to the south about 120 feet for 7,000 feet, the distance between the most northern and the most southern wells. This first successful well is called the Tully well or well "A 1" of group A (not used at present). Later a well was sunk about 4 miles farther north or about 1 mile south of Cardiff village. The drill hole penetrated through 244 feet of the Hamilton shales, 500 feet of the limestones belonging to the Helderberg group, and finally 100 feet in red shales of the salt group, when it was abandoned.

The twenty wells now in use by the company are in groups, four wells in each group. The distance between the groups is 1,000 feet from north to south and 400 feet between the wells of the same group in the same direction, while the distance from the east to the west between the wells of the group is but 150 feet. Thus each group of wells forms a rectangle of 400 feet by 150 feet with a well at each corner, and all the groups together occupy a rectangle 6,000 feet by 150 feet. The greater number of these wells were only sunk through the first rock-salt bed, though a second bed of 54 feet thickness was found in some of them. The results obtained in these borings are given in the following table:

Depth of salt wells at Tully, New York.

Well.	Depth to salt.	Thickness of salt-bed.	Well.	Depth to salt.	Thickness of salt-bed.	Well.	Depth to salt.	Thickness of salt-bed.
	Feet.	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*
A 1	1,218	48	C 3	1,070	45	E 2	1,040	44
B 1	1,175	318	C 4	1,057	44	E 3	1,011	61
B 2	1,435	50	D 1	1,072	43	E 4	1,023	39
B 3	1,170	228	D 2	1,075	43	F 1	1,014	35
B 4	1,456	25	D 3	1,053	48	F 2	992	47
C 1	1,085	47	D 4	1,053	52	F 3	1,012	40
C 2	1,069	45	E 1	1,030	53	F 4	974	41

From this table it may be concluded that the first layer of the rock-salt deposit underlaying the southern part of Onondaga county is at least 43 feet thick and separated from a second layer of salt of 54 feet thickness by 25 feet of shales except in those parts where the wells of group B are situated.

KANSAS.

In 1890, the salt production of Kansas was 882,666 barrels, valued at $397,199. The rapid growth of the industry in this State has placed Kansas prominently on the list of salt-producing States, and accounts for the decrease in production at other localities which formerly supplied the sections of country which now depend upon the Kansas product.

OHIO.

In 1890, 231,303 barrels of salt, valued at $136,617, was made in the State of Ohio, being about 20,000 barrels less than the production for 1889.

Estimated production of salt in Ohio from 1882 to 1890.

Years.	Barrels.	Value.	Years.	Barrels.	Value.
1882	400,000	$300,000	1887	365,000	$219,000
1883	350,000	231,000	1888	380,000	247,000
1884	320,000	201,600	1889	250,000	162,500
1885	306,847	199,450	1890	231,303	136,617
1886	400,000	260,000			

WEST VIRGINIA.

The production of salt in West Virginia during the year 1890 is estimated at 229,938 barrels, valued at $134,688.

Estimated production of salt in West Virginia from 1882 to 1890.

Years.	Barrels.	Value.	Years.	Barrels.	Value.
1882	400,000	$300,000	1887	225,000	$135,000
1883	320,000	211,200	1888	220,000	143,000
1884	310,000	195,300	1889	200,000	130,000
1885	223,184	145,070	1890	229,938	134,688
1886	250,000	162,500			

LOUISIANA.

The production of salt at the Petite Anse mine in 1890 was 273,553 barrels (39,079 tons), valued at $132,000, being 46,493 barrels less than the product for 1889.

Production of the Petite Anse salt mine from 1882 to 1890.

Years.	Short tons.	Years.	Short tons.
1882	25,550	1887	47,750
1883	37,130	1888	55,214
1884	31,355	1889	45,588
1885	41,898	1890	39,079
1886	41,957		

UTAH.

In 1890, 427,500 barrels of salt, valued at $126.100, were produced in Utah. The following table gives the production and value of salt made in the Territory during the years 1883 to 1890, inclusive:

Production of salt in Utah, 1883 to 1890.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Barrels.			*Barrels.*	
1883	107, 143	$100, 000	1887	325, 000	$102, 375
1884	114, 285	80, 000	1888	151, 785	32, 000
1885	107, 140	75, 000	1889	200, 000	60, 000
1886	164, 285	100, 000	1890	427, 500	126, 100

CALIFORNIA.

The salt made in Alameda, San Bernardino, and San Diego counties in 1890 amounted to 62,363 barrels, valued at $57,085.

In San Bernardino county the Cook-Perkins mine produced 150 tons of salt, valued at $1,275. The whole product was shipped to the stock ranges of Arizona and New Mexico for supplying cattle. The area of the deposit includes 160 acres, there being about 90 acres exposed to the surface. The quarrying is done with giant powder for 30 cents per ton; the transportation charge from the mine or quarry to the railroad, 17 miles, is $4.50 per ton.

Five years ago about 200 tons were shipped to New Mexico for the stock ranges, in blocks weighing from 200 to 1,400 pounds. It was put out on the ranges at convenient places for the cattle to use, and there are a number of the blocks still on the range, shipped that year, with no material loss. It has saved the stock ranchers the employment of herders to a considerable extent, as the cattle will invariably come back from once to twice a month to the place where the salt is deposited for their use.

IMPORTS AND EXPORTS.

Salt imported and entered for consumption in the United States, 1867 to 1890, inclusive.

[Calendar years ending December 31 from 1886 to 1890; previous years end June 30.]

Years.	In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
1867	254, 470, 862	$696, 570	229, 304, 323	$336, 302	....	....	$1, 032, 872
1868	308, 446, 080	915, 546	219, 975, 096	365, 458	....	....	1, 281, 004
1869	297, 382, 750	895, 272	256, 765, 240	351, 168	....	....	1, 246, 440
1870	288, 479, 287	797, 194	349, 776, 433	507, 874	68, 597, 023	$87, 048	1, 392, 116
1871	283, 993, 799	800, 454	274, 730, 573	355, 318	64, 671, 139	66, 008	1, 221, 780
1872	258, 232, 807	788, 893	257, 637, 230	312, 569	57, 830, 929	60, 155	1, 161, 617
1873	239, 494, 117	1, 254, 818	388, 012, 132	525, 585	86, 756, 628	86, 193	1, 866, 596
1874	358, 375, 496	1, 452, 161	427, 294, 209	649, 838	105, 613, 913	126, 896	2, 228, 895
1875	318, 673, 091	1, 200, 541	401, 270, 315	549, 111	110, 249, 440	119, 607	1, 869, 259
1876	331, 266, 140	1, 153, 480	379, 478, 218	462, 106	118, 760, 638	126, 276	1, 741, 862
1877	359, 005, 742	1, 059, 941	444, 044, 370	532, 831	132, 433, 972	140, 787	1, 733, 559

Salt imported and entered for consumption in the United States, etc.—Continued.

Years.	In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
1878	352, 190, 963	$1, 062, 995	414, 813, 516	$483, 909	100, 794, 611	$96, 898	$1, 643, 802
1879	375, 286, 472	1, 150, 018	434, 760, 182	532, 706	94, 060, 114	95, 841	1, 778, 565
1880	400, 970, 531	1, 180, 082	449, 743, 872	548, 425	109, 024, 446	119, 667	1, 848, 174
1881	412, 442, 291	1, 242, 543	529, 361, 042	658, 068	133, 395, 065	144, 347	2, 044, 958
1882	329, 969, 300	1, 086, 932	399, 100, 228	474, 200	184, 777, 569	147, 058	1, 708, 190
1883	312, 911, 360	1, 035, 946	412, 988, 686	451, 001	142, 065, 567	154, 671	1, 641, 618
1884	340, 759, 010	1, 093, 628	441, 613, 517	433, 827	126, 605, 276	122, 463	1, 649, 918
1885	351, 276, 969	1, 030, 029	412, 322, 341	386, 858	140, 067, 018	121, 429	1, 538, 316
1886	319, 232, 750	966, 993	366, 621, 223	371, 000	103, 360, 362	94, 721	1, 432, 714
1887	275, 774, 571	850, 069	343, 216, 331	328, 201	106, 577, 947	107, 089	1, 285, 359
1888	238, 921, 421	620, 435	272, 650, 231	246, 022	118, 459, 088	111, 120	977, 577
1889	180, 906, 293	627, 134	234, 499, 685	249, 232	97, 960, 624	100, 123	976, 489
1890	172, 611, 041	575, 260	243, 756, 044	252, 848	98, 279, 719	96, 648	924, 756

Salt of domestic production exported from the United States from 1790 to 1890, inclusive.

Fiscal years ending September 30 until 1842, and June 30 since.	Quantity.	Value.	Calendar years ending December 31 from 1886 to 1890; previous years end June 30.	Quantity.	Value.
	Bushels.			*Bushels.*	
1790....................	81, 935	$8, 236	1860....................	475, 445	$129, 717
1791....................	4, 208	1, 052	1861....................	537, 401	144, 046
1830....................	47, 488	22, 978	1862....................	897, 506	228, 109
1831....................	45, 847	26, 848	1863....................	584, 901	277, 838
1832....................	45, 072	27, 914	1864....................	635, 519	296, 088
1833....................	25 069	18, 211	1865....................	589, 537	858, 109
1834....................	89, 064	54, 007	1866....................	670, 644	300, 980
1835....................	126, 230	46, 483	1867....................	605, 825	304, 030
1836....................	49, 917	31, 943	1868....................	624, 970	289, 936
1837....................	99, 133	58, 472	1869....................	442. 947	190, 076
1838....................	114, 155	67, 707	1870....................	298, 142	119, 582
1839....................	264, 337	64, 272	1871....................	120, 156	47, 115
1840....................	92, 145	42, 246	1872....................	42, 603	19, 978
1841....................	215, 084	62, 765	1873....................	73, 323	43, 777
1842....................	110, 400	39, 064	1874....................	81, 657	14, 701
1843 (nine months).....	40, 678	10, 262	1875....................	47, 094	16, 273
1844....................	157, 529	47, 755	1876....................	51, 014	18, 378
1845....................	131, 500	45, 151	1877....................	65, 771	20, 133
1846....................	117, 627	30, 520	1878....................	72, 427	24, 968
1847....................	202, 244	42, 333	1879....................	43, 710	13, 612
1848....................	219, 145	73, 274	1880....................	22, 179	6, 613
1849....................	312, 063	82, 972	1881....................	45, 455	14, 752
1850....................	319, 175	75, 103	1882....................	42, 085	18, 265
1851....................	344, 061	61, 424	1883....................	54, 147	17, 321
1852....................	1, 467, 676	89, 316	1884....................	70, 014	26, 007
1853....................	515, 857	119, 729	1885....................	*a*4, 101, 587	26, 488
1854....................	548, 185	159, 026	1886....................	4, 828, 863	29, 590
1855....................	536, 073	156, 879	1887....................	4, 685, 080	27, 177
1856....................	698, 458	311, 495	1888....................	5, 359, 237	32, 986
1857....................	576, 151	190, 699	1889....................	5, 378, 450	31, 405
1858....................	533, 100	162, 650	1890....................	4, 927, 022	30, 079
1859....................	717, 257	212, 710			

a Pounds from 1885.

Customs districts and ports into which salt was imported during the fiscal years ending June 30, 1889 and 1890.

Districts.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
Aroostook, Me	551, 700	$1, 716	599, 800	$1, 796
Baltimore, Md	45, 895, 135	70, 467	83, 254, 515	63, 871
Bangor, Me	3, 923, 232	4, 148	3, 073, 575	2, 631
Bath, Me			4, 112, 148	4, 289
Boston and Charlestown, Mass	97, 562, 445	144, 220	78, 003, 812	120, 468
Brazos de Santiago, Tex	2, 667	20	6, 750	37
Buffalo Creek, N. Y	300	2		
Cape Vincent, N. Y	190	1		
Champlain, N. Y	81, 936	598	26, 070	94
Charleston, S. C	4, 446, 104	4, 479	1, 620, 453	2, 178
Chicago, Ill	18, 291, 318	61, 884	22, 680, 301	84, 361
Cincinnati, Ohio	223, 776	608	836, 000	1, 168
Cuyahoga, Ohio	1, 248, 800	2, 007	875, 640	4, 725
Detroit, Mich	389, 200	2, 642	358, 800	2, 578
Duluth, Minn	145, 600	949		
Fairfield, Conn	979, 840	1, 107	672, 707	734
Galveston, Tex	16, 932, 789	22, 714	4, 970, 007	8, 812
Gloucester, Mass	41, 419, 640	39, 552	61, 517, 700	55, 196
Huron, Mich	649, 600	8. 871	308, 000	1, 818
Indianapolis, Ind	2, 688, 000	7, 297	1, 680, 000	5, 426
Kansas City, Mo	3, 438, 016	11, 521	4, 590, 014	12, 690
Key West, Fla	89, 048	106	107, 410	150
Miami, Ohio			56, 000	633
Milwaukee, Wis	884, 800	5, 037	1, 012, 617	6, 365
Mobile, Ala	4, 959, 360	8, 093		
New Haven, Conn	2. 757, 701	2, 701	2, 065, 507	1, 892
New Orleans, La	35, 878, 849	36, 091	37, 006, 746	69, 295
Newport News, Va	5, 145, 490	10, 197	2, 278, 270	7, 081
New York, N. Y	140, 710, 084	265, 287	109, 844, 216	219, 608
Norfolk and Portsmouth, Va	28, 711, 512	43, 037	15, 308, 354	31, 126
Omaha, Nebr	691. 332	1, 824		
Oregon	230, 400	588	402, 040	1, 578
Oswegatchie, N. Y	33, 600	300		
Paso del Norte, Tex. and N. Mex	358, 796	2, 032	469, 365	3, 399
Passamaquoddy, Me	4, 837, 767	11, 838	4, 293, 705	8, 469
Pensacola, Fla	896, 000	681	5, 600, 000	7, 938
Philadelphia, Pa	45, 987, 154	63, 881	36, 748, 437	48, 788
Portland and Falmouth, Me	18, 160, 494	19, 793	11, 736, 366	17, 188
Providence, R. I	9, 257, 260	8, 071	7, 448, 762	6, 915
Puget Sound, Wash	453. 827	1, 330	8, 354, 550	11, 287
Richmond, Va	3, 128, 389	5, 264	3, 438, 954	9, 223
St. Johns, Fla	348, 000	335	471, 400	547
St. Louis, Mo	1, 702, 610	7, 640	650, 530	3, 325
San Diego, Cal	5, 760	39	1, 440	28
San Francisco, Cal	7, 729, 004	26, 138	17, 272, 427	65, 067
Savannah, Ga	11, 258, 273	9, 550	9, 982, 813	12, 169
Superior, Mich	39, 200	420		
Tampa, Fla			27, 000	70
Vermont	24, 827	244	7, 200	10
Waldoboro, Me			549, 690	568
Willamette, Oregon	4, 699, 950	14, 741	8, 966, 959	83, 059
Wilmington, N. C	10, 933, 943	13, 679	6, 603, 007	10, 697
All other customs districts, etc	3, 593, 439	4, 331	1, 649, 807	2, 078
Total	582, 377, 147	943, 071	506, 039, 864	950, 925

Exports of salt, by countries, during the fiscal years 1889 and 1890.

Countries to which exported.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
Argentine Republic			24,400	$190
Brazil	6,200	$39		
Central American States:				
Costa Rica	238,412	1,687	188,115	1,483
Guatemala	5,960	64	3,560	47
Honduras	20,879	263	25,568	318
Nicaragua	159,750	1,726	175,619	1,812
Chile	1,600	16	4,000	55
China	3,000	15	3,000	18
Colombia			411,880	4,392
Danish West Indies			1,540	16
France	4,000	40		
French Guiana			4,200	38
Miquelon Langley, and St. Pierre Islands	500	5	2,480	38
French Possessions	89,280	506	107,800	575
Nova Scotia, New Brunswick, and Prince Edward Island	12,193	161	3,150	35
Quebec, Ontario, Manitoba, and the Northwest Territory	909,990	4,856	65,290	348
British Columbia	434,400	2,774	561,276	3,149
Newfoundland and Labrador	291,825	634	14,740	131
British West Indies	72,224	797	161,737	1,735
British Honduras	3,515	37	8,800	80
British possessions in Australasia	116,000	580	25,000	150
Hawaiian Islands	837,740	3,963	839,500	4,317
Haiti	11,460	158	8,113	109
Japan	19,800	122	29,500	152
Mexico	136,540	1,637	201,325	2,527
Netherlands			10,000	125
Dutch West Indies			300	3
Azore, Madeira, and Cape Verde Islands	3,777	43	2,000	18
Russia, Asiatic	1,794,800	7,212	1,314,000	6,539
San Domingo	54,730	607	44,450	385
Cuba	34,025	209	37,060	273
United States of Colombia	530,060	6,055		
Uruguay	1,540	20		
All other islands and ports	9,700	60	3,200	20
Total	5,803,900	34,266	4,281,692	29,073

BROMINE.

Bromine is produced as a by-product of the salt industry. The mother liquor from the salt works in West Virginia, Ohio, and Michigan are treated for this purpose and the bromine saved. The bromides contained in the mother liquor are oxidized by manganese dioxide in West Virginia and Ohio; potassium chlorate is the favorite oxidizing agent in Michigan, because of the large proportion of chloride of calcium in the liquor.

The product of this substance in the last three years is given below.

Product of bromine in the United States from 1888 to 1890.

States.	1888.	1889.	1890.
	Pounds.	*Pounds.*	*Pounds.*
Ohio	64, 540	165, 973	101, 813
West Virginia	81, 124	90, 028	118, 184
Michigan	61, 609	45, 968	59, 696
Pennsylvania	100, 113	116, 922	108, 154
Total	307, 386	418, 891	387, 847

The total value of the product in 1890 was $96,962, the price being about 27 cents per pound on the average for that year. In the preceding years a syndicate of producers has kept the price comparatively free from competition at 31 cents per pound.

The use of bromine as a disinfectant is increasing slowly. Of course the bulk of the product goes into the manufacture of potassium and sodium bromides.

BORAX.

BY CHARLES G. YALE.

STABLE CONDITION OF THE INDUSTRY.

The manufacture of borax in this country has for the past three years undergone little variation as regards either production made or net profits realized, the product during this period having amounted to nearly 9,000,000 pounds per annum. California and Nevada continue to be the only sections of the United States in which this salt is manufactured in commercial quantities; nor is it made, except in a small way, anywhere else on the Western continent, though a good deal of the crude material is exported from the west coast of South America, mostly from Chile and Peru. Some small shipments of the borate of lime have also been made from a deposit of that mineral found east of the Andes, in the States of La Plata.

Production.—The annual and the total production of manufactured borax made to date in the States of California and Nevada is exhibited in the following table:

Borax produced in the United States.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
Prior to 1873	1,750,000	1879	1,584,966	1885	8,000,000
1873	2,000,000	1880	3,860,748	1886	9,778,290
1874	4,000,000	1881	4,045,405	1887	11,000,000
1875	5,433,658	1882	4,236,291	1888	7,830,000
1876	5,180,810	1883	6,500,000	1889	8,800,000
1877	3,727,280	1884	7,000,000	1890	9,500,000
1878	2,802,800				

Of the quantity of this salt manufactured prior to 1873 nearly the whole was the product of the California and the American borax companies, operating in the localities hereinafter mentioned, three-fourths of this quantity having been made by the California company.

The considerable falling off noted since 1887 is explained by the following statement of facts: During the six months that elapsed between the date of the enactment of the present tariff law, in January, 1883, and the first day of July, when it went into effect, the English dealers in borax, in anticipation of higher prices ruling here, and with a view to discouraging our home producers, sent to this country, while imports were so free from duty, 5,000,000 pounds of boracic acid, the equivalent of 7,000,000 pounds of the salt. As our own manufacturers kept on making meantime a large product, the price of borax, instead of advancing, as was expected, declined, by reason of large accumulations on the American market, to 4½ cents per pound, being less than cost of production. In this strait our home manufacturers entered into an arrangement whereby this output has, for the past three years, been curtailed to the extent denoted by the figures given for these years respectively. They could easily turn out here a great deal more of this salt, but self-preservation requires that production should be restricted to something like present figures.

DISCOVERY AND FIRST WORKINGS.

Although a brief account of the discovery and earlier workings of the borate fields of California and Nevada has been given in previous reports of this series, it may be in order to recapitulate the history of this industry in these States and bring it to the present time.

The credit of having first discovered a workable deposit of borax on the Pacific coast belongs to the late Dr. John A. Veatch, a skilled mineralogist and indefatigable explorer, who in his day made many other important mineral discoveries, he having also contributed much valuable matter to the mining literature of California. Having detected the presence of boracic acid in certain springs located in the northern part of the State, Dr. Veatch spent much time exploring the adjacent country in the hope of finding a deposit of borax that would prove of commercial value. Proceeding from one spring to another a little boracic acid was found in nearly all, in the most of them hardly more than a trace, but generally enough to keep alive the hope that inspired this tireless devotee of science. After traveling hundreds of miles, much of the distance being made on foot and under circumstances of great discomfort, Dr. Veatch came upon an extensive deposit of the biborate of soda, the material occurring in the form of crystals imbedded in the mud at the bottom of a lagoon situated on the margin of Clear lake, Lake county, California. To this lagoon was afterwards given the name Borax lake. Although this find occurred in 1856, not until 1864 was any attempt made at working this deposit, the California Borax Company having during the latter year commenced the business of recovering these crystals and converting them into a marketable commodity, which process was conducted after the following manner:

Coffer dams, made of boiler iron, each 4 feet square by 6 feet deep, and open at both ends, having been prepared, were suspended over the water from pontoons and suddenly dropped, their weight carrying them down through the softer mud to the more compact clay below. This done, the contents of these coffer dams were raised and thrown into troughs, through which a stream of water being passed, the mud and smaller crystals were washed out and returned to the lake, only the larger crystals being retained. These latter were then dissolved in hot water and recrystallized in tanks lined with lead, under which treatment they yielded their full weight of first-class borax, less the weight of the small percentage of mud they contained.

The above was, of course, a very wasteful process, as the company at the end of four years came to realize. Their stock of available material, confined to the upper 5 feet of mud, had by this time become depleted to an extent that considerably curtailed production, and even threatened it with entire cessation at no distant day, a dénouement that was finally precipitated by the occurrence of an excessive rainfall, which so filled up the lake that further operations at that point became impracticable.

In this emergency the company transferred their labors to a small pond near by, the water of which holds in solution the salts of soda in the following proportions: Sodium carbonate, 75.4; sodium chloride, 8.3; sodium biborate, 16.3 per cent.

Neither the water here nor the mud beneath contains any crystals. Under these changed conditions a different method of treatment had to be adopted from that before employed; nor did the company succeed in finding a method entirely adapted to these changed conditions, even after much experimentation had been made. What worked right in laboratory practice failed to give satisfaction when tried on a large scale. The plan of concentrating the water by boiling and evaporating the solution in small pans was finally adopted. The borax and the carbonate were then crystallized together, after which the latter was washed away, its greater solubility making this an easy matter. Some 4,000 of these evaporating pans, holding from 2 to 3 gallons each, constituted a part of the plant here in use.

The California Borax Company continued work at this place until 1874, when they were obliged to suspend operations owing to the low price of this salt consequent on the large production made at the newly discovered salines in Nevada. During the period they were at work this company turned out a total of about one and a quarter million pounds of refined borax, for which they received an average of 25 cents per pound. Notwithstanding the high price obtained for their product the investment proved an unfortunate one for the company.

While the manufacture of borax was so struggling to obtain a foothold in California, a company of San Francisco capitalists undertook the manufacture of this salt in Nevada, the site of their operations being a small circular lake situated near Ragtown, Churchill county. This lake, about 2 miles in circumference and very deep, is walled in on every side but the southwest by steep banks, which spring up from the narrow beach to a height of 200 feet or more. The slope of these banks is as smooth and regular as the face of an artificial mound, the upper edge being on a level with the surface of the surrounding country. But for the absence of other confirmatory evidence this lake, so deep and nearly circular, might be supposed to occupy the crater of an extinct volcano. The water of this lake carries in solution a small percentage of boracic acid and chloride of sodium or common salt. The region about abounds in "alkali flats," shallow depressions, in which the water during the wet season collects to a depth of a few inches, and, evaporating, leaves a slight deposition of the above salts behind. Much of the soil here appears, in fact, to be impregnated with these and other saline substances. In the vicinity of this lake occurs a remarkable deposit of carbonate of soda, fully described in the Fourth Annual Report of the California State Mineralogist. In utilizing the water of this lake the plan was adopted of pumping it up into troughs, through which it was carried out and discharged on an alkali flat near by and there evaporated, the crystallized borax being left behind. After a short trial this enterprise was abandoned, the borax produced being limited in quantity and of low grade, owing to the presence of the baser salts and other impurities, there being in the neighborhood neither fuel nor other facilities for refining the crude material on the spot. In addition to these natural disadvantages there was manifested here, as there had been at Borax lake, a surprising ignorance of the conditions as well as of the methods of procedure requisite to success.

Proceeding to notice in the order of their occurrence these abortive efforts at manufacturing borax on the Pacific Coast, the enterprise inaugurated at Sand Springs, in Nevada, next claims attention. At this locality, situated on an extensive alkali flat, in Churchill county, there was put up by the American Borax Company, in the year 1870, reduction works having a capacity of one ton of the refined salt per day. After operating these works for a period of about three years this company relinquished the business, mainly for the same causes that had militated against their predecessors in the field. About the same time, or a little later, a small plant was put up on a deposit of the borates similar to that at Sand Springs and situated 50 miles to the northwest of that locality. Although near the line of the Central Pacific railroad, insuring the operators at that point cheap transportation, results here did not differ from those previously reached in both California and Nevada.

Before the last-mentioned company had closed its works the discovery of much richer as well as more extensive deposits of borax in both of these States had served so to reduce the price of this commodity that it could no longer be profitably produced by any of the parties previously engaged in its manufacture on the coast.

Concerning the salines so discovered, their subsequent outfit, and active workings, enough has been said in previous volumes of this series to make unnecessary any detailed account of the same here. Every year has seen some improvements made in the industry in the way of more perfect appliances and processes, and through the introduction of which, production has been so cheapened that the manufacturer has, without any material advance in the price of the salt, been able to realize a living profit where before he had failed to do so.

As the improvements above alluded to are well represented by what has, during the year under review, been accomplished by the San Bernardino Borax Company, an article bearing on the subject is reproduced, with slight omissions, from the last Annual Report of the California State Mineralogist. As this article, prepared by Dr. Henry De Groot, describes also the general features of the saline belonging to that company, the character of the crude material there obtained, and the manner of its occurrence, together with the mechanisms and methods employed in its reduction, it may, in so far as the above particulars are concerned, be accepted as describing with much accuracy this entire class of properties.

THE SEARLES BORAX MARSH.

This marsh is situated in the northwestern corner of San Bernardino county, California, occupying a portion of township 25 south, range 43 east, Mount Diablo meridian.

The site is distant from San Francisco southeast 500 miles; from San Bernardino, the shire town of the county, due north 175 miles; and from Mojave, nearest station on the Southern Pacific railroad, northeast 72 miles; these distances being measured by the usually traveled routes.

Physical peculiarities and probable origin.—Locally considered, Searles' marsh lies near the center of an extensive mountain-girdled plain, to which the phrases "alkali flat," "dry lake," "salt bed," and "borax marsh" have variously been applied. The contents and physical features of this basin-shaped depression well justify the several names that have been so applied to it. It is, in fact, a dry lake, the bed of which has been filled up in part with the several substances named. Its contents do, in reality, consist of mud, alkali, salt, and borax, largely supplemented with volcanic sand. This depression, which has an elevation of 1,700 feet above sea level, and an irregular oval shape, is about 10 miles long and 5 miles wide, its longitudinal axis striking due north and south. It is surrounded on every side but the south by high mountains, the Slate range bounding it on the east and north, and the Argus range on the west, the view to the south being shut out by low mountains, conical peaks, and broken hills which break away to the southeast. Conspicuous in that direction stands a series of splintered buttes, so slender and pointed that the name "Needles" has been applied to them.

No doubt but this basin was once the bed of a deep and wide-extended lake, the remains of a former inland sea. The shore line of this lake is distinctly visible along the lower slopes of the surrounding mountains at an elevation of 600 feet above the surface of the marsh. Farther up, one above the other, faint marks of former water lines can be seen showing the different levels at which the surface of the ancient lake has stood. In the course of time this lake was extinguished, having been filled up with the wash from the adjacent mountains, originally much taller than they are to-day.

What may have originally been the depth of this lake has not yet been ascertained, borings put down 300 feet having failed to reach bed rock.

Borings commenced in 1887 disclosed the following underlying formations, the successive strata passed through having been observed and noted by Superintendent Searles, who had the work in charge

1. Two feet of salt and thenardite.
2. Four feet of clay and volcanic sand, containing a few crystals and bunches of hanksite.
3. Eight feet of volcanic sand and black, tenacious clay, with bunches of trona of black, shining luster, from inclosed mud.
4. Eight-foot stratum, consisting of volcanic sand containing glauberite, thenardite, and a few flat hexagonal crystals of hanksite.
5. Twenty-eight feet of solid trona of uniform thickness—other borings showing that this valuable mineral extends over a large area.
6. Twenty-foot stratum of black, slushy, soft mud, smelling strongly of hydrosulphuric acid, in which there are layers of glauberite, soda, and hanksite. The water has a density of 30 degrees Baumé.
7. Two hundred and thirty feet (as far as explored) of brown clay, mixed with volcanic sand and permeated with hydrosulphuric acid.

Overlying No. 5 a thin stratum of a very hard material was encountered. Being difficult to penetrate and its character not recognized, this was simply called "hard stuff," its more exact nature being left for future determination.

Whatever the agencies that in the first place scooped out the bed of this lake, or however it came afterwards to be drained of its water, the process by which it has since been filled up, as well as the sources of its wonderful enrichment, is well understood. The rocks of the surrounding region being mainly of volcanic origin, abound with the various salts found in this marsh. As these rocks have undergone decomposition these salts, set free, have mingled with and become constituent parts of the soil. The rains falling on this soil have carried it, together with the salts it contained, down and deposited it in this central basin, filling it up to the extent now seen. That this filling-up process must have been slow in a climate marked by such extreme aridity, admits of no question. The wash from the watershed of this basin is not large, and would have been extremely limited but for the cloud-bursts that occasionally occur on the surrounding mountains, and which in former times were probably heavier and of more frequent occurrence than at present. Only in excessive wet winters do more than a few small streams flow down the ravines eroded in the rim of this basin, and these dry up almost as soon as the rain ceases to fall. But the filling up of this ancient lake has not been due solely to the soil washed in by the surface water. It has been greatly hastened by the large quantities of dust and sand swept in by the strong winds that blow here periodically from the west. While the solfataric action may have had something to do with the production of these salts, it seems probable that their presence here is mainly, if not wholly, due to the source above indicated.

As is the case with all salines of like character, this has no outlet. The water that comes into it can escape only by evaporation, which process goes on here very rapidly for two-thirds of the year. While most of the water contained in this basin is subterranean, a little during very wet winters accumulates and stands for a short time on portions of the surface. In no place, however, does it reach a depth of more than a foot or two, hardly anywhere more than 3 or 4 inches. Within the limits of the actively-producing portion of the marsh, which covers an oblong area of about 1,700 acres, the water stands on a tract of some 300 acres for a longer period than it does elsewhere, but even here it nowhere reaches a depth of more than a foot. Between this 300-acre tract and the main flat lying a little lower, there interposes a slight ridge which prevents the surface water from escaping to the lower ground. This entire productive section is, in fact, slightly depressed below the general level of the flat, to which circumstance, no doubt, its greater fertility is due. As certain degrees of moisture are necessary to maintain the process of capillary attraction, this goes on at this lower point, to which the water gravitates, with greater steadiness and activity than elsewhere.

After a slight winter rainfall, causing the water to subside to an unusually low level, the restoration of these surface deposits goes on slowly and may even be wholly arrested.

Mineral substances found.—This water, which is of a dark brown color, and strongly impregnated with alkali, has a density of 28° Baumé. The salts obtained from it by crystallization contain carbonate and chloride and biborate of sodium, with a large percentage of organic matter. Summarized, the following minerals have been found associated with the borax occurring in the Searles marsh: Anhydrite, calcite, celestite, cerargyrite, colemanite, dolomite, embolite, gay-lussite, glauberite, gold, gypsum, halite, hanksite, natrone, soda, niter, sulphur, thenardite, tincal, and trona, the most of these occurring, of course, in only minute quantities. There is, however, reason to believe that hanksite will yet be found abundantly, both here and in the other salines of this region.

The submerged tract above described is called the "crystal bed," the mud below the water being full of large crystals, which occur in nests at irregular intervals to a depth of 3 or 4 feet; many of these crystals, which consist of carbonate of soda and common salt, with a considerable percentage of borate, are of large size, some of them measuring 7 inches in length. The water 15 feet below this stratum of mud contains, according to Mr. C. N. Hake, who made, not long since, a careful examination of these deposits, carbonate of soda, borax, and salts of ammonia. The ground in the immediate vicinity, a dry hard crust about one foot thick, contains, on the same authority:

Composition of ground near Searles' marsh, California.

	Per cent.
Sand	50
Sulphate of soda	16
Common salt	12
Carbonate of soda	10
Borax	12

The borax here occurs in the form of the borate of soda only, no ulexite (borate of lime) having yet been found.

Gathering.—It is the overlying crust mentioned that constitutes the raw material from which the refined borax is made. The method of collecting it is as follows: When this crust, through the process of efflorescence, ever active here, has gained a thickness of about 1 inch, it is broken loose and scraped into windrows far enough apart to admit the passage of carts between them, and into which it is shoveled and carried to the factory located on the northwest margin of the flat 1 to 2 miles away. As soon as removed, this incrustation begins again to form, the water charged with the saline particles brought to the surface by capillary attraction evaporating and leaving these particles behind. This process having been suffered to go on for three or four years, a crust thick enough for removal is again formed; the supposition being that this incrustation, if removed, will, in like manner, go on reproducing itself indefinitely. In order to determine the proportionate growths of the various salts contained in this crust while undergoing this recuperative process, Mr. Hake took samples representing, respectively, six months, two, three, and four years' growth. From the ground from which these samples were taken, the crust has been removed several times during the preceding twelve years.

The analyses of these samples gave the following results:

Composition of old and new crusts at Searles' borax marsh, California.

	Six months' growth.	Two years' growth.	Three years' growth.	Four years' growth.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Sand	58.0	55.4	52.4	53.3
Carbonate of soda	5.2	5.0	8.1	8.0
Sulphate of soda	11.7	6.7	16.6	16.0
Chloride of soda	10.9	20.0	11.1	11.8
Borax	14.2	12.9	11.8	10.9
Totals	100.0	100.0	100.0	100.0

The above determination shows that the first six months' growth is richest in borax, and that the proportion of carbonate of soda to borax increases regularly. The presence of so much sand as is here indicated is caused by the high winds that blow at intervals, bringing in great quantities of that material from the mountains to the west. This sand, it is supposed, facilitates the formation of the surface crust by keeping the ground in a porous condition.

Process of manufacture.—The crude stuff having been collected on the marsh and hauled to the factory in the manner stated, is thrown on the dumping ground close by, a stock of several thousand tons being kept constantly on hand. As required, this material is carted into the works and thrown into dissolving tanks filled with a boiling saline solution, and there kept until it is completely dissolved, free ammonia being meantime copiously given off. The heat supplied to the tanks consists of steam passed through a coil placed near their bottoms, this coil being pierced with many minute holes for the escape of the steam. The various salts being dissolved, there is left at the bottom of the tank an insoluble residue, chiefly mud and sand. The hot solution having been left about eight hours to settle and clarify, is run off into long wooden crystallizing tanks and allowed to cool, which requires from five to nine days, according to the temperature of the weather. The product of the first crystallization is a somewhat impure article of borax, slightly discolored by organic matter, and which is either sold as "concentrates" or redissolved in boiling mother liquid, and the resultant solution allowed to cool to 120° F. From the solution thus obtained borax of a superior quality is made. By a system of careful experimentation kept up for a year Superintendent Searles has succeeded in extracting the borax from the crude material treated up to a high percentage, very little of the salt being lost.

Reduction works.—While these are as complete perhaps as any extant, additional improvements are contemplated here, not, however, with a view to increasing the output so much as effecting further economy in the manufacture of the salt. Although the present works are capable of turning out over one hundred tons refined borax per month, they are not run to their full capacity, a slightly restricted production having been found expedient. The buildings occupied by the plant consist of a dissolving, a concentrating, a refining, and a boiler and engine house, and all those numerous other buildings required about an establishment of this kind.

Fuel and water supply.—The fuel formerly used in these works consisted of greasewood and sagebrush, the only kinds found in the country. No trees grow here. For about three years an acceptable substitute for these shrubs has been found in crude petroleum, which, besides proving far more economical and less troublesome, affords a steadier heat.

The water used here for drinking and for feeding the boilers is obtained from a group of springs 7½ miles distant in the Argus Mountains, whence it is brought in through iron pipes, being delivered at the works under a 1,000-foot head. It is abundant and of excellent quality, being soft and pure. The water required for other purposes is derived from artesian wells, of which 14, sunk on the border of the marsh to a uniform depth of 55 feet, afford an ample supply. This water, which flows steadily, rising from 5 to 10 feet above the surface, contains about 1 per cent of carbonate of soda, strong traces of borax, and salts of ammonia equal to about 18 grains per gallon. It answers well for dissolving the crude material and for most other uses about the works, in which the consumption is large.

Labor, wages, transportation, etc.—This company employs about 60 men in the several departments of the business, subdivided and paid as follows: One foreman, $8 per day; 4 mechanics, each $4 per day; 50 laborers, each $2 per day; 2 teamsters, $100 per month; 3 persons in the clerical force $150 per month, the company boarding all but the latter. The sum paid out on labor account amounts to $50,000 annually. Owing to favorable climatic conditions operations can be continued here nearly the whole year round. On an average not more than one month in twelve is lost, the cause of stoppage being rains, sandstorms, and repairs. It may here be observed that the wages paid by the other borax companies operating on the Pacific coast do not vary much from the above, except that they are as a general thing somewhat less.

For their transportation service this company requires about 50 animals, most of them being heavy draft mules. For hauling the raw material from the marsh to the factory horses are used. For transporting the manufactured article to Mojave, the shipping and receiving station on the Southern Pacific railroad, and bringing back supplies mules are employed. Twenty of these animals constitute a team, which, being attached to two large wagons coupled together and capable of carrying a total of 15 tons, make the trip to Mojave, 72 miles distant, in eight days. As the country to be traversed is an arid and sandy desert, water having to be carried part of the way, freighting over it is attended with heavy expense, it costing the company more than twice as much to get their products from their plant to Mojave as from that place to Eastern markets.

The Pacific Coast Borax Company.—This company consists of a consolidation, recently effected, of the Pacific Borax, Salt, and Soda Company, the new organization taking in also the several properties known as the Chetco borax mine of Oregon, the Death Valley and the Amargosa borax deposits, the Calico borate mine, and the Alameda refinery. The amount of marketable borax turned out by this company from their four salines now actively worked aggregated in the present year (1890) about 6,000 tons, the most of it being the Calico, the Teel's marsh, and the Columbus marsh deposits, with a small contribution from the Chetco mine. Owing to change of ownership and the many natural disadvantages under which they require to be worked, nothing has for the past three years been done with either the Death Valley or the Amargosa deposit.

The Calico mine.—This deposit, situated in the Calico district, San Bernardino county, California, is remarkable in that it occurs in the form of a vein or ledge, being exploited in the same manner as that class of deposits. Though discovered in 1883, only for the past few years has this mine been actively worked, the plan of operating here being as follows: The crude material, which occurs intermixed with shale, jasper, and carbonate of lime, is broken out, hoisted to the surface, and dumped into cars which carry it to the ore bins near by. Taken from these it is loaded on wagons and hauled to the town of Daggett and there shipped by rail to the company's Alameda refinery, located on the bay of San Francisco, where it undergoes final treatment, about 700 tons of the raw material being handled per month. This material is priceite and carries about 34 per cent. boracic acid. In stoping it out much blasting is required. After being brought to the surface it has to be carefully assorted, being intermixed with so much foreign matter. The deposit is now believed to be extensive, as it measures fully 4 feet between the walls and can be traced by the croppings for a distance of nearly 2 miles. This company employs at the Calico mine 45 men and 45 animals, two 20-mule teams doing the hauling to Daggett. The entire labor force employed by them, the Alameda works included, amounts to about 150 men.

Rhodes marsh.—There were turned out here in the year 1890 about 700 tons of concentrated borax, the product being sacked and sold in that shape or sent elsewhere for refining. This company employs about 15 or 20 men, the most of them Indians, these latter being found very serviceable hands. The company manufactures a considerable quantity of common salt, which is used in the reduction of silver ores at the several mills in the neighborhood.

The Preservaline Company, an eastern incorporation, which has been in existence about four years, has built a refinery on the Columbus marsh at a point 12 miles east from the town of Columbus. The output, amounting to some 250 tons per year, is handled by the New York Chemical Importing Company, which converts the most of it into a "preservaline" for keeping meats and other food products, the efficacy of this article being enhanced by the addition of certain other antiseptics. This company, which employs about 20 men, undertook the manufacture of boracic acid, but finding the business unprofitable abandoned it after having expended a considerable sum in the experiment. This acid could be made on the Pacific coast were the present tariff on the imported article slightly increased.

The Chetco deposit.—This is located in Curry county, Oregon, the crude material, priceite, occurring in the shape of bowlders weighing from a few ounces up to several hundred pounds. These being buried irregularly in the earth, with little or no surface indications, the exploitation of the deposit becomes troublesome and costly, disadvantages that are measurably offset by the great richness of the material and the facilities that exist at the spot for shipping it by sea. Professor Silliman, who carefully examined this mineral, obtained the following mean of three analyses:

Analysis of priceite from Chetco, Oregon.

	Per cent.
Boracic acid	49.00
Lime	31.83
Water	18.29
Alumina, salt, and oxide of iron	.96
Total	100.08

The absence of soda distinguishes this mineral from ulexite and cryptomorphite, making it a new species, named after Prof. Thomas Price, of San Francisco. Several hundred tons of this material have lately been gathered and sent to the Alameda refinery, where it was treated with excellent results. A hundred tons of it has also been reduced elsewhere to pure boracic acid. Notwithstanding the difficulty of working it, this deposit is likely to prove valuable. Eight men are kept steadily employed in the work of hunting after and getting it out. When extracted it is shipped by sea to the Alameda works and there reduced.

The Saline Valley deposit.—A discovery of comparatively recent date is located to the east of the White mountains, Inyo county, California, being distant easterly 60 miles from Alvord, a shipping station on the Carson and Colorado railroad. The marsh in which the crude material, the borate of soda, occurs covers some 20,000 acres, though the more fertile portion, so far as known, is confined to less than one-tenth that area. Over much of this the borate of soda incrustation varies from 3 to 6 inches in thickness. The owners of this more fertile section, Messrs. Conn & Trudo, have erected here a plant after the usual style, having a capacity of 40 tons concentrated per month. A working force of thirty men is employed here. Water for these works is brought through iron pipes from the mountains to the west, a distance of 1½ miles. Mesquite trees, which make an excellent fuel, are abundant in the neighborhood. An average of eight assays of this crude material, made by Mr. John Fleming, gave 66.83 per cent. boracic acid. During 1890 Messrs. Conn & Trudo turned out 400 tons of concentrated borax, with nearly as much the preceding year.

While the borax industry on the Pacific coast is in a fairly prosperous condition, this would be changed should there occur any largely increased production, as lower prices would inevitably follow, thereby extinguishing the narrow profit margin that at present exists.

In this country the "spot" price of borax is understood to mean price delivered on cars at shipment points on either of the transcontinental railroads. During the past year this price has been 6½ cents per pound for the concentrated and 7 cents for the refined article, this being for not less than car load lots. Eastern prices exceed the above by 1 to 1½ cents per pound. Latterly the most of the salt has been shipped by rail directly east from points of production, only such amount going to San Francisco as is intended for shipment by sea, plus consumption on the Pacific coast, which latter is less than 100 tons.

GRAPHITE.

The production of graphite in 1889 amounted to 7,003 short tons of crude mineral. The value of the product in its first selling condition was $72,662. In 1890 the product consisted of 1,000 tons from Michigan worth at the mines, $12,000; 500 tons from Pennsylvania and New Jersey, marketed in pulverized form for $20,500, and 600,000 pounds (estimated) of refined from the Ticonderoga, New York, mines worth $45,000. The qualities of graphite differ widely. The uses and prices depend upon the quality. The inferior qualities are used in the manufacture of paints, foundry facings, crucibles, and lubricants. There is no uniformity in the value per ton. The production of the finer grade used for lead pencils is limited to the Ticonderoga mines.

Graphite imported into the United States from 1867 to 1890.

Years ended—	Unmanufactured.		Manufactured.	Total.
	Quantity.	Value.		
	Cwt.			
June 30, 1867	27, 113	$54, 131	....	$54, 131
1868	68, 620	149, 083	....	149, 083
1869	74, 846	351, 004	....	351, 004
1870	80, 795	269, 291	$833	270, 124
1871	51, 628	136, 200	3, 754	139, 954
1872	96, 381	329, 030	....	329, 030
1873	157, 539	548, 613	....	548, 613
1874	111, 992	382, 591	....	382, 591
1875	46, 492	122, 050	....	122, 050
1876	50, 589	150, 709	17, 605	168, 314
1877	75, 361	204, 630	18, 091	222, 721
1878	60, 244	154, 757	16, 909	171, 666
1879	65, 662	164, 013	24, 637	188, 650
1880	109, 908	278, 022	22, 941	300, 963
1881	150, 927	381, 966	31, 674	413, 640
1882	150, 421	363, 835	25, 536	389, 371
1883	154, 893	361, 949	21, 721	383, 670
1884	144, 086	286, 393	1, 863	288, 256
1885	110, 462	207, 228	....	207, 228
1886	83, 368	164, 111	....	164, 111
1887	168, 841	331, 621	....	331, 621
Dec. 31, 1888	184, 013	353, 990	....	353,990
1889	177, 381	378, 057	....	378, 057
1890	255, 955	594, 746	....	594, 746

MINERAL PAINTS.

Ocher.—The total amount of ocher produced in 1889 was 15,158 short tons, valued at $177,472. In 1890 the product was 17,555 short tons, valued at $237,523. The domestic production of ochers, umbers, siennas, and metallic paints has shown a decided increase in the past few years. In "Mineral Resources of the United States, 1883–'84," the annual production of ocher was given at 7,000 tons, valued at $84,000. No reliable information regarding umber, sienna, and iron ore ground for paint was obtainable at that time. During the last two or three years operators have shown a greater amount of interest in the effort to publish statistics, and in most instances give valuable assistance in the prosecution of the work. The statistics for 1890 are made up from direct returns from all known producers. The values are not obtained from current market reports, but represent the total amount received by producers for their output. The results of the present investigation show that the annual production of American ocher has increased 10,555 short tons, or 150.8 per cent., since 1884. The value of the product in the same time has increased from $84,000 to $237,523, or 182.8 per cent. From the following table the annual increase of this now important industry since 1884 can be noted:

Annual production of ocher since 1884.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1884	7,000	$84,000	1888	10,000	$120,000
1885	3,950	43,575	1889	15,158	177,472
1886	6,300	91,850	1890	17,555	237,523
1887	8,000	75,000			

Ocher is produced in a number of localities in the United States. Previous to 1889 no statistics of the production by States have been published. In the following table the figures for that year are obtained from the report of the Eleventh Census. Those for 1890 are compiled from individual returns made to the Survey.

Production of ocher in 1889 and 1890, by States.

States.	1889.		1890.	
	Short tons.	Value.	Short tons.	Value.
Alabama	336	$3,500	850	$4,100
Colorado	50	150	1,000	15,000
Georgia	2,512	29,720	800	12,800
Maryland	616	12,000	7,000	84,000
Massachusetts	80	750	300	2,700
Missouri	....	....	2,200	30,000
New York	....	....	365	4,493
Pennsylvania	7,922	103,797	4,173	61,456
Vermont	1,884	7,800	....	....
Virginia	1,658	18,755	1,367	22,972
Wisconsin	100	1,000	....	....
Total	15,158	177,472	17,555	237,523

Exports and imports.—The first shipment of American ocher to Europe is reported to have been made in December, 1890, from the mines of the Cartersville Ocher Company, at Cartersville, Georgia, a consignment of 50 tons to England. The imports since 1867 are shown in the following tables:

Ocher imported from 1867 to 1883.

Fiscal years ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral, French and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,878	$385	....	$35,374	....	$2,083	1,430,118	$9,923
1868	6,949	338	....	11,165	....	500	3,670,093	32,102
1869	65,344	2,496	2,582,336	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,466	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,768	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,852	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	1.524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	26,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42.568
1880	91,293	4,283	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	8,201,880	80,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883 (*a*)	187,978	6,143	1,549,968	18,788	6,972	885	7,022,615	90,593

a Since 1883 classified as "dry" and "ground in oil."

Imports of ocher of all kinds from 1884 to 1890.

Years ended—	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
June 30, 1884	6,164,359	$63,973	108,966	$4,717	6,273,325	$68,690
1885	4,983,701	51,499	79,666	3,616	5,063,363	55,115
Dec. 31, 1886	4,939,183	53,593	112,784	6,574	5,051,967	60,167
1887	5,957,200	58,162	54,104	7,337	6,011,304	65,499
1888	6,574,608	64,123	43,142	9,690	6,617,750	73,813
1889	5,540,267	52,502	51,068	9,072	5,591,330	61,574
1890	....	....	....	....	6,471,863	71,953

Imports of umber from 1867 to 1890.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	2,147,842	$15,946	June 30, 1879	986,106	$6,959
1868	845,178	2,750	1880	1,877,645	17,271
1869	570,771	6,159	1881	1,475,835	11,126
1870	708,825	6,813	1882	1,923,648	20,494
1871	470,392	7,064	1883	785,794	8,419
1872	1,409,822	18,203	1884	2,946,675	20,654
1873	845,601	8,414	1885	1,198,060	8,504
1874	729,864	6,200	Dec. 31, 1886	1,262,930	9,187
1875	513,811	5,596	1887	2,385,281	16,536
1876	681,199	7,527	1888	1,423,806	14,684
1877	1,101,422	10,213	1889	1,555,070	20,887
1878	1,038,880	8,302	1890	1,556,823	19,329

Metallic paint.—The use of metallic paint continues to increase. The total product in 1889 was 21,026 short tons, valued at $286,294. In 1890 the product was 24,177 tons, valued at $340,369. The returns for

1887 showed a product of 12,000 tons worth $235,000, and those for 1888 a product of 14,000 valued at $280,000. From the above it will be seen that while the product has increased over 100 per cent. since 1887 the value has increased only 45 per cent. Part of this comparative decrease in value arises from the estimates for previous years, being based upon the average market prices as quoted through technical periodicals, while the values for 1889 and 1890 represent the total amount actually received by the operators for their product. The following table shows the production for 1889 and 1890 by States:

Production of metallic paint in 1889 and 1890, by States.

States.	1889.		1890.	
	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*	
Alabama	3,000	$30,000		
California			40	$480
Colorado	90	2,500	1,300	22,100
New Jersey			10	130
New York	3,658	63,698	5,224	72,952
Ohio	540	11,123	637	16,341
Pennsylvania	8,849	128,036	8,955	145,243
Tennessee	3,057	24,237	5,386	46,068
Vermont			500	6,000
Wisconsin	1,832	26,700	2,125	31,055
Total	21,026	286,294	24,177	340,369

Venetian and Indian reds.—In addition to what are known as "metallic" red and brown paints, there were produced in the United States in 1890, 4,000 short tons of Venetian and Indian "reds," valued at $84,100. Mr. S. P. Wetherill, president of the S. P. Wetherill Company of Philadelphia, one of the two concerns engaged in the manufacture of these paints, states that the manufacture of Venetian red in this country began about 1878 (*a*), and from its beginning the growth of the demand has been gradual, as each barrel had to displace one of English manufacture, and the prejudice in favor of the latter was very strong.

The English reds with which the American product competes are made from the same material (sulphate of iron), but by a different process of manufacture. The American market was formerly entirely dependent upon English manufactures for their supply of what is known in the trade as "English Venetian red;" that is, red of high color which can only be made practically from sulphate of iron. Mr. Wetherill adds that the cost of importing English red before the American works started was 3 cents per pound. About one-third of the Venetian red now used in this country is of domestic make and the price has been reduced about 50 per cent. in the contest for trade. The cost of the crude material is quite as cheap in this country as abroad, and the domestic production is increasing every year, with the prospect of eventually excluding the foreign article.

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a No statistics of previous production have been published.

White lead.—The product of white lead in 1890 was 155,272,115 pounds (or 77,636 short tons), valued at $9,382,967, against 84,000 tons in 1888. The product for 1889 has not been determined in this investigation, though it is probable that the Census Office (division of manufactures) will publish the figures for that year. This subject was not considered as coming within the scope of the mining investigation of the Census Office, the limit in that division being reached with the production of pig lead. It is tolerably certain that the product of white lead in 1889 was somewhat less than that of 1888, and more than that of 1890. In 1889 the Corroders' Association or "Trust" was succeeded by an incorporated company organized by the stockholders of the companies and members of the firms formerly in the trust. All but eight of the former independent operators are now incorporated in the National Lead Company, the various plants being operated as branches of one corporation, with one central office and board of directors.

Red lead, litharge, and orange mineral.—The total product of red lead in 1889 was 11,821,084 pounds, or 5,911 tons, valued at $726,844. Of litharge there were 10,230,090 pounds, or 5,115 tons, worth $665,631. The amount of orange mineral produced was 730,000 pounds, or 365 tons, worth $48,000. No statistics of these three subjects have been published since 1887, when the combined product was estimated at 7,000 tons, though the amounts actually reported by producers for that year were: red lead, 2,634 short tons; litharge, 1,492 short tons, and orange mineral, 245. The returns, however, were incomplete.

Red lead, white lead, and litharge imported from 1867 to 1890.

Year ended—	Red lead.		White lead.		Litharge.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
June 30, 1867	926, 843	$53, 087	6, 636, 508	$430, 805	230, 382	$8, 941
1868	1, 291, 144	76, 773	7, 533, 225	455, 698	250, 615	12, 225
1869	808, 686	46, 481	8, 948, 642	515, 783	187, 333	7, 767
1870	1, 042, 813	54, 626	6, 228, 285	365, 706	97, 398	4, 442
1871	1, 295, 616	78, 410	8, 337, 842	483, 392	70, 889	3, 870
1872	1, 513, 794	85, 644	7, 153, 978	431, 477	66, 544	3, 396
1873	1, 583, 089	99, 891	6, 331, 373	408, 986	40, 799	2, 379
1874	756, 644	56, 305	4, 771, 509	323, 926	25, 687	1, 440
1875	1, 048, 713	73, 131	4, 354, 131	295, 642	15, 767	950
1876	749, 918	54, 884	2, 546, 766	175, 776	47, 054	2, 562
1877	387, 260	28, 747	2, 644, 184	174, 844	40, 331	2, 347
1878	170, 608	9, 364	1, 759, 608	113, 638	28, 190	1, 499
1879	143, 237	7, 237	1, 274, 196	76, 061	38, 495	1, 667
1880	217, 033	10, 397	1, 906, 931	107, 104	27, 389	1, 222
1881	212, 423	10, 009	1, 068, 030	60, 132	63, 058	2, 568
1882	288, 946	12, 207	1, 161, 889	64, 493	54, 592	2, 191
1883	249, 145	10, 503	1, 044, 478	58, 588	34, 850	1, 312
1884	265, 693	10, 589	902, 281	67, 918	54, 183	1, 797
1885	216, 449	7, 641	705, 535	40, 437	35, 283	1, 091
Dec. 31, 1886	597, 247	23, 038	785, 554	57, 340	51, 409	1, 831
1887	371, 299	16, 056	804, 320	58, 602	35, 908	1, 302
1888	529, 665	23, 684	627, 900	49, 903	62, 211	2, 248
1889	522, 026	24, 400	661, 694	56, 875	41, 230	1, 412
1890	450, 402	20, 718	742, 196	57, 659	48, 283	2, 146

Whiting and Paris white.—These substances and terra alba are still only articles of import, as per the following tables:

Imports of whiting and Paris white from 1867 to 1890.

Years ended—	Whiting and Paris white, dry.		Years ended—	Whiting and Paris white, dry.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867........	8,168,123	$40,879	June 30, 1879........	1,365,867	$5,976
1868........	5,530,042	19,390	1880........	1,808,577	7,503
1869........	3,438,396	17,289	1881........	1,974,913	7,806
1870........	5,650,728	27,293	1882........	1,722,711	6,675
1871........	5,219,396	24,710	1883........	2,216,018	8,396
1872........	6,392,717	31,464	1884........	3,910,829	15,189
1873........	6,197,017	32,622	1885........	1,401,783	6,157
1874........	3,749,122	24,734	Dec. 31, 1886........	770,248	3,547
1875........	4,170,569	22,491	1887........	907,281	2,999
1876........	2,605,332	18,270	1888........	407,065	1,679
1877........	2,390,333	11,269	1889........	1,142,198	3,768
1878........	1,871,374	7,903	1890........	1,636,490	6,387

Imports of terra alba from 1869 to 1890.

Years ended—	Not aluminous.		Aluminous.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
June 30, 1869	....	$7,002.00	....	....
1870	....	7,911.00	....	....
1871	....	183,028.00	....	....
1872	....	6,444.00	....	....
1873	....	2,235.00	....	$44,994.00
1874	....	1,029.00	....	56,821.00
1875	....	....	....	45,726.00
1876	....	27,897.00	....	20,876.00
1877	....	45,171.00	....	344.75
1878	....	33,509.00	....	683.46
1879	....	33,250.00	....	7,081.30
1880	....	34,718.00	....	14,737.08
1881	....	30,186.00	....	9,796.56
1882	283,946	1,572.00	12,008,101	30,522.37
1883	149,782	800.00	10,592,552	19,583.00
1884	....	....	10,066,496	25,187.89
1885	....	....	20,510,540	41,878.21
Dec. 31, 1886	....	....	15,988,807	33,228.00
1887	....	....	10,824,749	29,809.00
1888	....	....	20,899,516	40,761.00
1889	....	....	28,945,674	60,292.00
1890	....	....	27,563,730	46,187.00

BARYTES.

The amount of barytes produced in 1889 was 21,460 short tons, valued at $106,313. The producing States were: Illinois, 200 tons; Missouri, 7,558 tons; North Carolina, 3,000 tons; and Virginia, 10,702 tons.

The product in 1890 was 21,911 tons. Of this amount Missouri produced 9,883 tons; North Carolina, 700 tons (*a*), and Virginia, 11,528 tons. There was no product from Illinois in 1890. The total value of the product in 1890 was $86,505. In computing this the value of the Missouri barytes is taken at the price paid at the mines by the St. Louis manufacturers.

Product of crude barytes from 1882 to 1890.

Years.	Quantity.	Value.
	Short tons.	
1882	22,400	$80,000
1883	30,240	108,000
1884	28,000	100,000
1885	16,800	75,000
1886	11,200	50,000
1887	16,800	75,000
1888	22,400	110,000
1889	21,460	106,313
1890	21,911	86,505

Imports of barium sulphate from 1867 to 1889.

Years ended—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
June 30, 1867	14,968,181	$141,273	....	....
1868	2,755,547	26,739	....	....
1869	1,117,335	8,565	....	....
1870	1,684,916	12,917	....	....
1871	1,385,004	9,769	....	....
1872	5,804,098	43,521	....	....
1873	6,939,425	53,759	....	....
1874	4,788,966	42,235	....	....
1875	2,117,854	17,995	....	....
1876	2,655,349	25,325	....	....
1877	2,388,373	19,273	....	....
1878	1,366,857	10,340	....	....
1879	453,333	3,496	....	....
1880	4,924,423	37,374	....	....
1881	1,518,322	11,471	....	....
1882	562,300	3,856	....	....
1883	411,666	2,489	....	....
Dec. 31, 1884	3,884,516	24,671	5,800,816	$8,044
1885	4,095,287	20,606	7,841,715	13,567
1886	3,476,691	18,338	6,588,872	8,862
1887	4,057,831	19,769	10,190,848	13,205
1888	3,821,842	17,135	6,504,975	9,037
1889	3,601,506	22,458	13,571,206	7,660

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[a] The total amount mined in North Carolina was 1,300 tons, but only 700 tons were marketed.

ASBESTOS.

The total amount of asbestos mined in the United States in 1889 and marketed was 30 tons, valued at $1,800. In 1890 the product increased to 71 tons, valued at $4,260. The production in each year was limited to California. Asbestos mines are being developed in Wyoming, but so far only a few tons have been mined and none of it has been marketed. A small amount obtained as a by-product in the quarrying of soapstone at Easton, Pennsylvania, is not considered in the product. The California product is manufactured into fire-proof paints and coatings, boiler and steam-pipe coverings, lubricants, and cement. The form of asbestos best adapted for the manufacture of fire-proof textile materials is more properly chrysotile, a variety of serpentine, and which may be distinguished from asbestos by yielding water when heated in a glass tube. The fibers of asbestos are short and brittle, while those of chrysotile are flexible, slightly elastic, and of great tensile strength. The most of the chrysotile used in the United States is produced in Canada, and the rapid progress made in the utilization of the mineral may be seen from the amount imported, as shown in the following table:

Asbestos imported from 1869 to 1890.

Years ended—	Unmanufactured.	Manufactured.	Total.
June 30, 1869	....	$310	$310
1870	....	7	7
1871	....	12	12
1872	....	....	....
1873	$18	....	18
1874	152	....	152
1875	4,706	1,077	5,783
1876	5,485	396	5,881
1877	1,671	1,550	3,221
1878	3,536	372	3,908
1879	3,204	4,624	7,828
1880	9,736	....	9,736
1881	27,717	69	27,786
1882	15,235	504	15,739
1883	24,369	243	24,612
1884	48,755	1,185	49,940
Dec. 31, 1885	73,026	617	73,643
1886	134,193	932	135,125
1887	140,264	581	140,845
1888	168,584	8,126	176,710
1889	254,239	9,154	263,393
1890	252,557	5,342	257,879

SULPHUR.

The total product of crude sulphur in the United States in 1889 was 1,150 short tons, worth $7,850. The producing localities were Nevada and Utah. In 1890, Utah produced 500 tons which was not placed on the market. Nevada produced 260 tons of refined sulphur, worth $30 per ton, at Winnemucca. This value is much higher than the prices at either the Atlantic or Pacific seaboards, owing to the fact that high freight rates put it out of the way of competition. It supplies a local demand and is principally consumed in the manufacture of sheep dip.

Work on the Louisiana properties is being prosecuted, but the operators do not expect to have any product before 1893.

Sicily continues to furnish the bulk of the world's supply, lack of facilities for mining and shipping Japanese sulphur keeping that source of supply in the background. Practically all the sulphur exported from Japan is shipped to San Francisco, and so does not compete with Sicilian sulphur. During 1890 facilities for reclaiming sulphur from alkali waste by the Chance process were introduced at a number of works in England, Austria, and France. Some of this regained sulphur is said to have been exported to the United States. In order to prevent the cutting of prices among the alkali-makers using this process and consequent unremunerative prices, a combination was formed in the shape of a limited company which shall control the entire sale of the sulphur.

The following table shows the imports of sulphur for the years 1867 to 1890, inclusive:

Sulphur imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Years ended—	Crude.		Flowers of sulphur.		Refined.		Oro.(a)	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
	Long tons.		*Long tons.*		*Long tons.*			
June 30, 1867....	24,544.10	$620,373	110.05	$5,509	250.55	$10,915	....	$636,797
1868....	18,150.55	446,547	16.48	948	64.75	2,721	....	450,216
1869....	23,589.69	678,642	96.59	4,576	645.04	27,149	....	710,367
1870....	27,379.60	819,408	76.34	3,927	157.24	6,528	$1,269	831,132
1871....	36,131.46	1,212,448	65.54	3,514	92.26	4,328	754	1,221,044
1872....	25,379.55	764,798	35.97	1,822	56.94	2,492	....	769,112
1873....	45,533.27	1,301,000	55.29	2,924	35.97	1,497	....	1,305,421
1874....	40,989.55	1,260,491	51.08	2,694	56.68	2,403	....	1,265,588
1875....	39,683.10	1,259,472	17.83	891	....	....	....	1,260,363
1876....	46,434.72	1,475,250	41.07	2,114	43.87	1,927	....	1,479,291
1877....	42,962.69	1,242,888	116.34	5,873	1,170.80	36,962	....	1,285,723
1878....	48,102.46	1,179,769	158.71	7,628	149.51	5,935	....	1,193,332
1879....	70,370.28	1,575,533	137.60	6,509	68.94	2,892	....	1,584,434
1880....	87,837.25	2,024,121	123.70	5,516	158.36	5,262	....	2,034,899
1881....	105,096.54	2,713,485	97.66	4,226	70.96	2,555	....	2,720,266
1882....	97,504.15	2,627,402	158.91	6,926	58.58	2,196	....	2,636,524
1883....	94,539.75	2,288,946	79.13	3,262	115.33	4,487	....	2,296,695
1884....	105,112.19	2,242,697	178.00	7,869	126.00	4,765	....	2,255,331
1885....	96,839.44	1,941,943	120.56	5,351	114.08	4,060	....	1,951,354
1886....	117,538.36	2,237,989	212.61	8,739	116.05	3,877	....	2,250,605
1887....	96,881.55	1,688,360	278.56	9,980	83.54	2,383	....	1,700,723
Dec. 31, 1888....	98,252.15	1,581,583	127.67	4,202	27.02	734	....	1,586,519
1889....	135,933.00	2,068,208	15.34	1,954	10.00	299	....	2,070.461
1890....	162,674.00	2,762,953	12.06	1,718	103.00	3,060	....	2,767,731

a Latterly classed under head of pyrites.

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1890.

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Dutch West Indies and Guiana	1,515	$15,427	......	....	......	....	......	....
England	30	1,211	425	$14,631	(†)	$16	2	$335
Scotland	24	910	472	13,231	160	3,961	806	19,287
Gibraltar	......	....	290	7,789	......	....	......	....
Quebec, Ontario, Manitoba, etc	......	....	......	....	12	264	......	....
Italy	46,941	1,439,839	41,819	1,194,000	47,494	1,161,367	64,420	1,458,138
Japan	456	16,291	437	13,137	256	7,548	224	4,528
Portugal	......	....	......	....	......	....	467	10,410
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698
DISTRICTS.								
Baltimore, Md	5,157	$157,828	3,882	$105,175	5,455	$138,202	6,969	$157,243
Barnstable, Mass	......	....	......	....	......	....	600	13,780
Boston and Charlestown, Mass	5,031	154,883	3,931	101,215	5,795	131,945	7,841	173,506
Charleston, S. C	......	....	......	....	526	12,267	605	13,812
Delaware, Del	450	13,500	......	....	......	....	890	21,907
Huron, Mich	......	....	......	....	12	264	......	....
Newark, N. J	......	....	1,071	31,802	462	13,240	443	16,175
New Orleans, La	172	5,705	150	4,750	......	....	100	2,067
New York, N. Y	24,524	721,092	21,867	654,997	28,240	690,989	36,543	827,193
Philadelphia, Pa	12,549	385,071	9,216	256,224	6,657	167,222	11,704	263,467
Providence, R. I	600	18,232	1,739	45,487	519	11,479	......	....
San Francisco, Cal	483	17,367	862	27,768	256	7,548	224	4,528
Savannah, Ga	......	....	725	15,370	......	....	......	....
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698

Countries whence exported and customs districts through which imported.	1880.		1881.		1882.		1883.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
England	1	$22	......	....	......	....	13	$379
Scotland	1,664	36,444	1,668	$43,311	755	$20,294	3	88
France	988	23,580	......	....	526	13,770	34	858
French West Indies	......	....	......	....	2	8	......	....
Greece	......	....	......	....	500	13,927	......	....
Italy	80,301	1,862,712	102,771	2,645,293	92,944	2,504,862	92,861	2,248,870
Japan	282	4,744	691	16,253	2,980	66,356	1,028	23,714
San Domingo	......	....	......	....	240	7,875	......	....
Spain	......	....	308	8,637	......	....	500	12,856
Spanish Possessions in Africa and adjacent islands	......	....	......	....	9	310	87	2,030
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795
DISTRICTS.								
Baltimore, Md	13,827	$313,342	16,477	$430,917	13,781	$364,384	11,977	$286,438
Beaufort, S. C	......	....	......	....	540	13,889	......	....
Boston and Charlestown, Mass	8,207	183,486	8,860	226,801	7,467	194,317	7,756	173,569
Charleston, S. C	1,061	25,398	3,065	78,741	6,025	161,281	4,051	106,235
Middletown, Conn	......	....	......	....	9	310	......	....
New Orleans, La	280	7,121	100	2,646	220	6,516	428	10,378
New York, N. Y	46,657	1,083,784	57,608	1,463,082	46,531	1,260,222	45,385	1,110,313
Philadelphia, Pa	10,679	254,892	17,987	477,547	14,839	408,611	22,772	549,095
Providence, R. I	1,256	31,155	650	17,507	1,244	33,086	585	13,830
Richmond, Va	......	....	......	....	660	17,760	......	....
San Francisco, Cal	1,270	28,824	691	16,253	6,054	151,284	1,072	24,572
Savannah, Ga	......	....	......	....	586	15,842	560	14,365
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1890—Continued.

Countries whence exported and customs districts through which imported.	1884(*a*).		1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Belgium	....	....	190	$4,766	60	$1,718	....	....
Danish West Indies	....	....	....	....	....	....	861	$5,250
England	....	....	606	15,084	81	2,535	162	4,437
France	....	....	....	....	....	....	290	6,951
Quebec, Ontario, Manitoba, and the Northwest Territory	....	....	....	....	....	9	....	....
Italy	....	....	94,370	1,894,858	112,283	2,166,565	89,924	1,588,146
Japan	....	....	1,541	25,683	4,972	66,505	6,146	83,576
Spain	....	....	134	1,552	....	....	....	....
Total	105,143	$2,242,678	96,841	1,941,943	117,396	2,237,832	97,383	1,688,360
DISTRICTS.								
Baltimore, Md	15,037	$303,226	14,505	$285,006	19,307	$364,958	12,547	$225,669
Barnstable, Mass	650	16,163	480	11,040	1,617	35,385	1,152	22,816
Beaufort, S. C	600	13,259	610	12,847	....	....	....	....
Boston and Charlestown, Mass	5,294	112,152	5,125	99,712	3,681	69,898	4,850	85,575
Champlain, N. Y	....	....	....	....	....	9	....	....
Charleston, S. C	6,125	132,570	8,525	169,564	13,350	265,265	12,420	220,598
New Orleans, La	....	....	102	2,282	250	5,102	....	....
New York, N. Y	52,478	1,135,725	45,537	909,123	58,758	1,115,519	46,711	792,114
Philadelphia, Pa	18,786	401,568	18,696	381,010	15,568	300,749	15,267	269,216
Providence, R. I	651	15,517	1,840	37,422	1,265	25,930	600	11,291
San Francisco, Cal	5,522	112,598	1,421	33,937	3,600	54,517	3,176	50,521
All other customs districts	....	....	....	....	....	....	660	10,560
Total	105,143	2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360

Countries whence exported and customs districts through which imported.	1888.		1889.		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*	
Belgium	83	$1,993	180	$4,086	182	$3,995
Danish West Indies	....	....	....	....	550	9,076
England	310	7,200	305	8,337	4,898	101,100
Scotland	....	....	....	....	20	487
France	....	....	....	....	....	....
Quebec, Ontario, etc	....	....	....	....	....	....
Italy	92,528	1,499,720	123,260	1,935,368	115,240	1,800,585
Japan	6,332	72,729	6,446	77,853	21,031	221,316
Spain	....	....	....	....	....	....
Total	99,258	1,581,582	130,191	2,025,644	141,921	2,136,559
DISTRICTS.						
Baltimore, Md'	11,989	$182,769	15,791	$234,693	21,198	$322,018
Barnstable, Mass	....	....	....	....	....	....
Beaufort, S. C	500	9,000	600	9,213	....	....
Boston and Charlestown, Mass	3,760	62,298	6,446	104,257	7,410	135,044
Champlain, N. Y	....	....	....	....	....	....
Charleston, S. C	12,005	199,048	23,377	364,859	15,752	255,106
New Orleans, La	200	3,845	....	....	200	3,397
New York, N. Y	50,486	816,286	60,922	959,872	66,359	983,754
Philadelphia, Pa	10,519	173,699	13,288	202,357	13,919	210,576
Providence, R. I	1,310	21,012	570	8,581	1,240	19,160
San Francisco, Cal	6,852	78,732	4,539	57,925	8,223	87,391
Savannah, Ga	....	....	2,345	44,244	5,560	86,826
Wilmington, N. C	1,582	25,893	1,753	28,443	2,040	32,800
All other customs districts	600	9,000	560	11,200	20	487
Total	99,258	1,581,582	130,191	2,025,644	141.921	2,136,559

a Sources not reported.

PYRITES.

Total product in 1889, 104,950 short tons; spot value, $202,119. Total product in 1890, 111,836 short tons; spot value, $273,745.

In the foregoing statements the pyrites included is only that which is consumed in the production of sulphuric acid. The increasing use of pyrites in the manufacture of acid is attested by the steady increase in the production of the mineral in the past few years. With properly constructed furnaces there can be little doubt that acid sufficiently pure for commercial purposes may be economically prepared from pyrites and compete successfully with that made from sulphur. For medicinal or other purposes when chemically pure acid is essential pyrites will not answer, owing to arsenic or other injurious impurities which are apt to be contained in the ore and which are not eliminated in the process of manufacture. The Chicora Fertilizer Company, of Charleston, South Carolina, is reported as having constructed its new and extensive fertilizer works so as to use pyrites entirely in the manufacture of acid. Other large producers have gone so extensively into the use of pyrites that the importations have increased and will probably increase still more rapidly. In Mineral Resources for 1886 were published comparative statements of the cost of acid produced respectively from sulphur and pyrites.

Production of pyrites in the United States from 1882 to 1890.

Years.	Quantity.	Value.
	Short tons.	
1882	13,440	$72,000
1883	28,000	137,500
1884	39,200	175,000
1885	54,880	220,500
1886	61,600	220,000
1887	58,240	210,000
1888	60,851	167,658
1889	104,950	202,119
1890	111,836	273,745

Imports of pyrites containing not more than 3½ per cent copper. (*a*)

Years.	Quantity.	Value.
	Long tons.	
1884	16,710	$50,632
1885	6,078	18,577
1886	1,605	9,771
1887	16,578	49,661

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[a] Previous to 1884 classed among sulphur ores; subsequent to 1887 classed among other iron ores.

LITHOGRAPHIC STONE.

Up to the close of 1890 no lithographic stone had been produced in the United States except for testing purposes. Active preparations for the development of properties said to contain lithographic stone of good quality were being made during the year in Blanco county, Texas, at Fincastle, Virginia, and near Little Rock, Arkansas. The property in Blanco county, Texas, is controlled by the Texas Lithographic Stone Company, composed of New York men engaged in the lithographing art. The resident superintendent is Mr. John A. Ropes, of Marble Falls, Burnet county, Texas, who reports that the company has placed on the grounds machinery for quarrying the stone, sawing it into slabs, and dressing for immediate use.

No work has been done on the Arkansas deposit except to get out samples for testing. The property is not favorably situated for shipping at present, being 80 miles from the railway, but on the line of two projected roads. Mr. Eben W. Kimball, vice-president of the Bank of Commerce of Little Rock, and who is interested in the property, states that the stone has been subjected to tests by lithographing firms in Philadelphia, St. Louis, and Nashville, and pronounced of excellent quality, comparing very favorably with Bavarian stone. Large quantities are reported available, and work will begin as soon as transportation facilities are obtained.

The deposit near Fincastle, Virginia, was discovered in April, 1890, by Mr. Alfred Beckley, of Fincastle. Mr. Beckley reports that the stone is confined to a ridge about 10 miles long. The stone has been tested by the Bell Lithographing Company, of Washington, District of Columbia, the Maryland Lithographing Company, of Baltimore, Maryland, and Johns & Co., of Cincinnati, Ohio, with evidently satisfactory results. Machinery suitable for quarrying is being placed upon the grounds, and the projectors express themselves as confident of producing a domestic stone which will fill all the requirements made upon it by the lithographic art.

Imports.—The imports of unengraved lithographic stone during late years have been as follows:

Lithographic stone imported into the United States from 1868 to 1890.

Years ended—	Value.	Years ended—	Value.
June 30, 1868	$13,258	June 30, 1880	$56,310
1869	17,044	1881	77,894
1870	14,225	1882	111,925
1871	21,311	1883	104,313
1872	36,146	1884	128,065
1873	44,937	1885	54,022
1874	36,902	1886	71,009
1875	41,963	Dec. 31, 1887	83,182
1876	47,101	1888	113,365
1877	44,508	1889	78,077
1878	42,709	1890	105,288
1879	37,746		

MINERAL WATERS.

By A. C. Peale.

The production of mineral waters for 1889 from 258 springs was 12,780,471 gallons, valued at $1,748,458. This was an increase of 3,201,823 gallons, and the increase in the value of the product was $69,156.

For 1890 the total number of springs was increased to 273, and of this number 220 springs have reported their sales, which amounted to 12,215,187 gallons, valued at $2,493,948. If for the 53 springs delinquent at the time of making up this report we estimate the product and value at the same as given for 1889, we would have a total production of 15,691,650 gallons, with a valuation of $2,839,223.

In the tables, however, the delinquent springs have been estimated at a little less than one-half the figures of 1889, giving for the totals the following figures: 13,907,418 gallons, with a value of $2,600,750. This is an increase from 1889 of 1,126,677 gallons and an increase in value of $852,292.

The total number of springs in the North Atlantic States reporting sales in 1889 was 60, which was 18 more than reported the previous year, and was only 4 less than the total on the list for that year. In 1890 the number reporting is 43 out of a total of 66. The 60 springs reporting in 1889 reported an increase of 1,249,665 gallons, with an increase in value of $224,467 over the total for 1888.

In 1890 there is an increase of 936,610 in the number of gallons reported, and if the sales of the 14 nonreporting springs were included it would doubtless be greater. There is, also, an increase of $703,937 in the total value of the water sold.

In the South Atlantic division the total number of springs increased from 41 in 1888 to 47 for 1889, and for 1890 has increased to 51, six new springs having been added and two taken from the list of 1889. There are 12 springs from which no reports have been received, but the 39 reporting give an increase in value over the sales of the 47 reporting in 1889.

The Northern Central States, from a total of 45 in 1888, increased to 86 in 1889, with an increase in production of over 4,000,000 gallons. In 1890 the list contains a total of 84, of which only 71 report, and the total production reported is slightly less than for the previous year. However, there is a considerable increase in the value of the production of the springs reporting as compared with the previous year. Seven springs were added to the list of 1889 and nine taken from it.

In the Southern Central States one more spring for 1889 is added to the number on the list as published in 1888, making the total 33. There is also a slight increase in production, but a falling off in its value. For 1890 three springs were added, bringing the total up to 36. Of these, however, only 30 have reported, and of course the figures are not as much greater than those of the previous year, as would have been the case had all reported.

The Western States and Territories in 1889 show a large increase in the number of spring waters used commercially, as compared with 1888, the number being 32 instead of 16. Notwithstanding this there was a decrease of over 400,000 gallons in the production as reported. One new spring is added to and one taken from the list for 1890, leaving the total 32. Of these 25 have reported, and they report an increase over the figures for 1889.

Production of mineral waters by States and Territories.

States and Territories.	1889.			1890.		
	Number of springs reporting.	Product.	Value of product.	Number of springs reporting.	Product.	Value of product.
		Gallons.			*Gallons.*	
Alabama	5	24,380	$2,430	3	12,500	$11,130
Arkansas	3	110,200	10,020	5	97,609	22,211
California	14	808,625	252,241	12	258,722	89,786
Colorado	8	304,600	87,400	7	445,435	92,125
Connecticut	3	4,410	2,630	2	4,700	1,950
Georgia	3	31,120	9,412	4	66,000	18,450
Illinois	10	2,207,216	38,697	7	61,900	12,470
Indiana	8	125,162	9,625	8	67,823	7,487
Iowa	5	12,780	2,490	5	55,440	8,330
Kansas	9	245,033	15,394	7	251,792	15,114
Kentucky	5	121,350	14,378	5	86,500	10,025
Maine	8	888,600	79,060	7	406,367	67,590
Maryland	4	74,160	12,057	2	1,550	162
Massachusetts	8	1,011,173	63,622	8	967,465	60,992
Michigan	7	333,345	67,987	6	453,000	98,700
Mississippi	2	8,870	1,174	2	24,762	5,020
Missouri	14	289,720	23,270	7	45,100	5,260
Nebraska				....	....	....
New Hampshire	2	60,000	4,500	3	930,000	340,500
New Mexico	4	32,700	10,225	3	17,365	5,357
New York	21	1,795,543	239,875	19	2,315,472	631,254
North Carolina	11	70,644	19,431	6	86,009	47,457
Ohio	11	251,610	26,696	8	82,290	13,246
Oregon	2	4,800	1,680	0	....	....
Pennsylvania	12	275,700	65,163	10	309,420	64,676
Rhode Island	2	47,000	2,975	2	77,000	2,975
South Carolina	2	50,520	10,046	0	....	....
Tennessee	4	21,500	5,000	2	85,000	17,000
Texas	14	213,700	10,354	13	298,200	16,040
Vermont	3	16,150	11,975	4	32,650	5,575
Virginia	22	397,395	141,476	20	421,466	158,016
Washington	3	113,748	14,943	2	23,248	3,943
West Virginia	4	21,900	5,360	6	28,000	6,850
Wisconsin	20	2,292,910	409,179	20	2,623,068	489,399
Other States (*a*)	5	513,907	77,793	5	1,569,734	162,283
Total	258	12,780,471	1,748,458	220	12,215,187	2,493,948

a For 1889 the States of Florida, Idaho, Minnesota, New Jersey, and South Dakota are included; for 1890 the States of Florida, Idaho, Minnesota, Nebraska, and South Dakota are included, only one spring reporting in each of these States.

Imports.—Prior to 1884 the Treasury Department did not distinguish natural mineral waters from those that were artificial; since 1883 the

distinction has been made, but the artificial waters have not been classified according to the receptacles in which they have been imported. The importation is shown in the two tables following, with a table of exports appended.

In 1889 there was an increase in the imports of artificial waters, but a decrease in the amount of natural mineral waters brought into the country, although the value was slightly above that of 1888.

In 1890 the importation of natural mineral waters was very greatly increased over that of 1889, while the importation of the artificial waters decreased.

The amount of natural and artificial mineral waters exported is trifling.

Mineral waters imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All, not artificial.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370, 610	$24, 913	3, 792	$360		$137			$25, 410
1868	241, 702	18, 438	22, 819	2, 052	554	104			20, 594
1869	344, 691	25, 635	9, 739	802	1, 042	245			26, 682
1870	433, 212	30, 680	18, 025	1, 743	2, 063	508			32, 931
1871	470, 947	34, 604	2, 320	174	1, 336	141			34, 919
1872	892, 913	67, 951			639	116			68, 067
1873	35, 508	2, 326			355	75	394, 423	$98, 151	100, 552
1874	7, 238	691			95	16	199, 035	79, 789	80, 496
1875	4, 174	471			5	2	395, 956	101, 640	102, 113
1876	25, 758	1, 899					447, 646	134, 889	136, 788
1877	12, 965	1, 328				22	520, 751	167, 458	168, 808
1878	8, 229	815					883, 674	350, 912	351, 727
1879	28, 440	2, 352			3	4	798, 107	282, 153	284, 509
1880	207, 554	19, 731					927, 759	285, 798	305, 529
1881	150, 326	11, 850			55	26	1, 225, 462	383, 616	395, 492
1882	152, 277	17, 010					1, 542, 905	410, 105	427, 115
1883	88, 497	7, 054					1, 714, 085	441, 439	448, 493

Imports for years 1884 to 1890.

Years ended—	Artificial mineral waters.		Natural mineral waters.	
	Gallons.	Value.	Gallons.	Value.
June 30, 1884	29, 366	$4, 591	1, 505, 298	$362, 651
1885	7, 972	2, 157	1, 660, 072	397, 875
Dec. 31, 1886	62, 464	16, 815	1, 618, 960	354, 242
1887	13, 885	4, 851	1, 915, 511	385, 906
1888	12, 752	4, 411	1, 716, 461	341, 695
1889	36, 494	8, 771	1, 558, 968	368, 661
1890	22, 328	7, 133	2, 322, 008	433, 281

Exports of natural mineral waters, of domestic production, from the United States.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1875	$162	1881	$1, 029
1876	80	1882	421
1879	1, 529	1883	(*a*) 459
1880	1, 486		

a None reported since 1883.

Production of natural mineral waters sold from 1883 to 1890.

Geographical division.	Springs reporting.	Gallons sold.	Value.
1883.			
North Atlantic....	38	2,470,670	$282,270
South Atlantic....	27	312,090	64,973
North Central.....	37	1,435,809	323,600
South Central.....	21	1,441,042	189,973
Western	6	169,812	52,787
	129	5,829,423	863,603
Estimated.........	60	1,700,000	256,000
Total.........	189	7,529,423	1,119,603
1884.			
North Atlantic....	38	3,345,760	328,125
South Atlantic....	27	464,718	103,191
North Central.....	37	2,070,533	420,515
South Central.....	21	1,526,817	147,112
Western	6	307,500	85,200
	129	7,715,328	1,084,143
Estimated.........	60	2,500,000	375,000
Total.........	189	10,215,328	1,459,143
1885.			
North Atlantic....	51	2,527,310	192,605
South Atlantic....	32	908,692	237,153
North Central.....	45	2,925,288	446,211
South Central.....	31	540,436	74,100
Western	10	509,675	86,776
	169	7,411,401	1,036,845
Estimated.........	55	1,737,000	276,000
Total.........	224	9,148,401	1,312,845
1886.			
North Atlantic....	49	2,715,050	177,969
South Atlantic....	38	720,397	123,517
North Central.....	40	2,048,914	401,861
South Central.....	81	822,016	58,222
Western	14	781,540	137,796
	172	7,037,917	899,365
Estimated.........	53	1,862,400	384,705
Total.........	225	8,950,317	1,284,070
1887.			
North Atlantic....	40	2,571,004	$213,210
South Atlantic....	34	614,041	147,149
North Central.....	38	1,480,820	208,217
South Central.....	29	741,080	87,946
Western	12	1,236,324	288,737
	153	6,643,269	945,259
Estimated.........	62	1,616,340	316,204
Total.........	215	8,259,609	1,261,463
1888.			
North Atlantic....	42	2,856,799	247,108
South Atlantic....	32	1,689,387	498,489
North Central.....	38	2,002,378	325,839
South Central.....	19	426,410	71,215
Western	15	1,853,679	421,651
	146	8,828,648	1,559,302
Estimated.........	52	750,000	120,000
Total.........	198	9,578,648	1,679,302
1889.			
North Atlantic....	60	4,106,464	471,576
South Atlantic....	47	646,239	198,032
North Central.....	86	6,137,776	604,238
South Central.....	33	500,000	43,356
Western	32	1,389,992	431,257
Total.........	258	12,780,471	1,748,458
1890.			
North Atlantic....	55	5,043,074	1,175,512
South Atlantic....	39	647,625	245,760
North Central.....	71	5,050,413	737,672
South Central.....	30	604,571	81,426
Western	25	869,504	253,578
	220	12,215,187	2,493,948
Estimated.........	53	1,692,231	106,802
Total.........	273	13,907,418	2,600,750

Alabama.—1889.—The number of springs on the list is not changed from that of 1888. The springs reporting are: Bailey Springs, Bailey Springs, Lauderdale county; Bladen Springs, Bladen Springs, Choctaw county; Healing Springs, Healing Springs, Washington county; Jackson White Sulphur Springs, Jackson, Clarke county; Matchless Mineral Water, Greenville, Butler county.

1890.—Only three springs have reported for 1890. They are: Bailey Springs, Bailey Springs, Lauderdale county; Healing Springs, Healing Springs, Washington county; Matchless Mineral Spring, Greenville, Butler county.

Arkansas.—1889.—Only three springs report for 1889, although the list for 1888 contained the names of five. The three reporting are: Arkansas Lithia Springs, Hope, Hempstead county; Fairchild's Potash Sulphur Springs, Potash Sulphur, Garland county; Mountain Valley Springs, Mountain Valley Springs, Garland county.

1890.—Two more springs are added for 1890, bringing the list up to five, as in 1888. All of these five report. They are: Arkansas Lithia Springs, Hope, Hempstead county; Fairchild's Potash Sulphur Springs, Potash Sulphur, Garland county; Dovepark Spring, Dovepark, Hot Spring county; Eureka Springs, Eureka Springs, Carroll county; Mountain Valley Springs, Mountain Valley, Garland county.

California.—1889.—Instead of nine springs, as in 1888, California has fourteen on the list for 1889. They are the following: Azule Seltzer Springs, San José, Santa Clara county; Bartlett Springs, Bartlett Springs, Lake county; Byron Hot Springs, Byron Hot Springs, Contra Costa county; Castalian Mineral Water, Inyo county; Coronado Natural Mineral Water, Coronado, San Diego county; El Toro Spring, Marin county; Geyser Soda and Litton Seltzer Springs, Sonoma county; Hot Springs of Elsinore, City of Elsinore, San Diego county; Napa Soda Springs, Napa Soda Springs, Napa county; Ojai Hot Springs, Ventura county; Pacific Congress Springs, San José, Santa Clara county; Pacific Congress Springs, Saratoga, Santa Clara county; Paraiso Springs, Paraiso Springs, Monterey county; Tolenas Springs, Fairfield, Solano county; Witter Springs, Lake county.

1890.—One new spring is added to and one taken from the list, making a total of fourteen; of these the following twelve report for 1890: Azule Seltzer Spring, San José, Santa Clara county; Bartlett Springs, Bartlett Springs, Lake county; Castalian Mineral Water, Inyo county; Coronado Natural Mineral Water, Coronado, San Diego county; El Toro Spring, Marin county; Geyser Soda and Litton Seltzer Springs, Sonoma county; Napa Soda Springs, Napa Soda Springs, Napa county; Ojai Hot Springs, Ventura county; Paraiso Springs, Fairfield, Solano county; Tuscan Spring, Red Bluff, Tehama county; Witter Springs, Upper Lake, Lake county.

Colorado.—1889.—Colorado's two springs of 1888 increased to eight in 1889; they are the following: Boulder Springs; Clark Magnetic Spring, Pueblo, Pueblo county; Fariss Magnetic Well, Pueblo, Pueblo county; Idaho Mineral Spring, Idaho Springs, Clear Creek county; Little Ute and Iron Duke Springs, Cañon City, Fremont county; Manitou, Navajo, and Shoshone Springs, Manitou Springs, El Paso county; Seltzer Springs, Springdale, Boulder county; Ute and Little Chief Iron Springs, Manitou, El Paso county.

1890.—The number of springs on the list remains the same, and all of the eight report their sales. They are: Boulder Springs, Boulder Springs, Boulder county; Clark Magnetic Mineral Spring, Pueblo, Pueblo county; Fariss Magnetic Well, Pueblo, Pueblo county; Idaho Mineral Spring, Central City, Gilpin county; Little Ute and Iron Duke Springs, Cañon City, Fremont county; Manitou, Navajo, and Shoshone Springs, Manitou, El Paso county; Seltzer Springs, Springdale, Boulder county; Ute and Little Chief Iron Springs, Manitou, El Paso county.

Connecticut.—1889.—Three springs make up the list for Connecticut, as follows: Aspinock Springs, Putnam Heights, Windham county; Oxford Chalybeate Spring, Oxford, New Haven county; Stafford Mineral Spring, Stafford Springs, Tolland county.

1890.—Only two springs, viz, Aspinoch Spring and Stafford Mineral Spring, report sales.

Florida.—1889.—For the first time Florida is represented on the list with one spring, viz: Cantonment Spring, near Pensacola, Escambia county, which reports also for 1890.

Georgia.—1889.—Three springs report. They are the following: Bowden Lithia and Georgia Bromine-Lithia Springs, Lithia Springs, Douglas county; Daniels' Springs, Greene county; Hughes' Springs, Floyd county.

1890.—One spring not on the list for 1889 is added, and all four report. They are: Bowden Lithia and Georgia Bromine-Lithia Springs, Lithia Springs, Douglas county; Daniels' Springs, Greene county; Hughes' Springs, Floyd county; Ponce de Leon Mineral Spring, Atlanta, Fulton county.

Idaho.—1889 and 1890.—As in the preceding years, Idaho is represented by the Idanha Springs of Soda Springs, Bingham county.

Illinois.—1889.—Ten springs report for this year, whereas only four reported in 1888. The following are the ten springs: Black Hawk Springs, Rock Island, Rock Island county; Diamond Mineral Spring, Grantfork, Madison county; Glen Flora Mineral Spring, Waukegan, Lake county; Hillsboro Mineral Spring, Hillsboro, Montgomery county, Kirkwood Mineral Spring, Kirkwood, Warren county; Peoria Magnetic Artesian Spring, Peoria, Peoria county; Perry Springs, Perry Springs, Pike county; Red Avon Mineral Spring, Fulton county; Sanicula Springs, Ottawa, La Salle county; Silver Springs, Greenup, Cumberland county.

1890.—One spring is taken from the list, and reports have been received from the following: Black Hawk Springs, Rock Island, Rock Island county; Diamond Mineral Spring, Grantfork, Madison county; Kirkwood Mineral Spring, Kirkwood, Warren county; Peoria Magnetic Artesian Spring, Peoria, Peoria county; Perry Springs, Perry Springs, Pike county; Red Avon Mineral Spring, Fulton county; Sanicula Springs, Ottawa, La Salle county.

Indiana.—1889.—Indiana's list increased from six in 1888 to eight in 1889. These are: Ash Iron Springs, De Gonia, Warwick county; Buffalo Saline Well, Millport, Washington county; Elliot's Mineral Spring, Shoals, Martin county; Kickapoo Magnetic Springs, Kickapoo, Warren county; King Mineral Springs, Muddy Fork, Clark county; Lodi Artesian Well, Lodi, Fountain county; Magnetic Mineral Spring, Terre Haute, Vigo county; West Baden Springs, West Baden, Orange county.

1890.—The number of springs on the list remains the same as for 1889, two springs being added and two taken from it. The springs reporting are: Elliot's Mineral Spring, Martin county; Kickapoo Magnetic Springs, Kickapoo, Warren county; King's Mineral Springs, Muddy Fork, Clark county; Lodi Artesian Well, Silverwood, Fountain county; Magnetic Mineral Spring, Terre Haute, Vigo county; West Baden Springs, West Baden, Orange county; French Lick Springs, French Lick, Orange county; Indiana Mineral Springs, Indiana Mineral Springs, Warren county.

Iowa.—1889.—In 1888 the list included three springs from this State; two were added for 1889, making the total number for which reports were received as follows: Black Hawk Springs, Salt Creek township, Davis county; Cherokee Magnetic Mineral Spring, Cherokee, Cherokee county; Lake View Medical Spring, Lake View, Sac county; Ottumwa Mineral Springs, Ottumwa, Wapello county; White Sulphur Springs, White Sulphur, Scott county.

1890.—One new spring is added to the list and reports were received from the following: Black Hawk Springs, Salt Creek township, Davis county; Cherokee Magnetic Mineral Spring, Cherokee, Cherokee county; Ottumwa Mineral Springs, Ottumwa, Wapello county; White Sulphur Springs, Scott county; Colfax Mineral Water, Colfax, Jasper county.

Kansas.—1889.—In 1888 Kansas had five springs reporting sales. They had increased in 1889 to nine, as follows: Blazing's Artesian Mineral Wells, Manhattan, Riley county; Boiling Springs, Mound Valley, Labette county; Geuda Mineral Springs, Geuda Springs, Cowley county; Great Spirit Springs, Cawker City, Mitchell county; Jewell county Lithium Springs, Montrose, Jewell county; Osage Mission Mineral Well, Osage Mission, Neosho county; Providence Mineral Wells, Providence, Butler county; Topeka Mineral Wells, Topeka, Shawnee county; Wichita Mineral Spring, Wichita, Sedgwick County.

1890.—One new spring is added to the list and two are taken from it, leaving the total eight. Seven report as follows: Blazing's Artesian Mineral Wells, Manhattan, Riley county; Geuda Mineral Springs, Geuda Springs, Cowley county; Great Spirit Springs, Cawker City, Mitchell county; Providence Mineral Wells, Providence, Butler county; Topeka Mineral Wells, Topeka, Shawnee county; Wichita Mineral Spring, Wichita, Sedgwick county; Iola Mineral Well, Iola, Allen county.

Kentucky.—1889.—No change so far as number of springs reporting is concerned is noted for 1888 to 1889. The following springs reported: Anita Springs, La Grange, Oldham county; Bedford Springs, Bedford, Trimble county; Blue Lick Springs, Blue Lick Springs, Nicholas county; Crab Orchard Springs, Crab Orchard, Lincoln county; St. Patrick's Well, Louisville, Jefferson county.

1890.—Kentucky's list remains the same for the previous year. The following five springs report sales: Anita Springs, La Grange, Oldham county; Bedford Springs, Bedford, Trimble county; Blue Lick Springs, Blue Lick Springs, Nicholas county; Crab Orchard Springs, Crab Orchard, Lincoln county; St. Patrick's Well, Louisville, Jefferson county.

Maine.—1889.—The list for this year showed an increase of one spring over those reporting for 1888. The following springs, eight in number, reported: Hartford Cold Spring, Oxford county; Cold Bowling Spring, York county; Keystone Spring, East Poland, Androscoggin county; Old Point Indian Spring, Somerset county; Poland Spring, Poland, Androscoggin county; Seal Rock Spring, Saco, York county; Underwood Springs, Falmouth Foreside, Cumberland county; Windsor Mineral Spring, Androscoggin county.

1890.—One spring on the list of 1889 reports no sales for 1890 and three springs new to the list are added, which makes the total number ten. The springs reporting are seven in number, as follows: Barker Mill Spring, Auburn, Androscoggin county; Crystal Springs, Auburn, Androscoggin county; Keystone Spring, East Poland, Androscoggin county; Poland Spring, South Poland, Androscoggin county; Underwood Springs, Falmouth Foreside, Cumberland county; Wilson Spring, North Raymond, Cumberland county; Windsor Mineral Spring, Lewiston, Androscoggin county.

Maryland.—1889.—Four springs reported, as against none for the preceding year. They are the following: Cecil Spring, Cowentown, Cecil county; Chattolanee Mineral Spring, Chattolanee, Baltimore county; Flintstone Mineral Springs, Flintstone, Allegany county; Strontia Mineral Spring, Brooklandville, Baltimore county.

1890.—Only two springs report. They are: Chattolanee Mineral Spring, Chattolanee, Baltimore county; Flintstone Mineral Springs, Flintstone, Allegany county.

Massachusetts.—1889.—Eight springs, an increase of two over 1888, reported sales for this year. The following are the ones reporting: Allandale Springs, West Roxbury, Suffolk county; Belmont Hill Spring, Everett, Middlesex county; Belmont Natural Spring, Everett, Middlesex county; Echo Grove Springs, West Lynn, Essex county; Everett Crystal Spring, Everett, Middlesex county; Sheep Rock Spring, Towell, Middlesex county; Simpson Spring, South Easton, Bristol county; Undine Spring, Brighton, Suffolk county.

1890.—One spring is added to the list, and eight springs in all report sales, as follows: Allendale Spring, West Roxbury, Suffolk county; Belmont Hill Spring, Everett, Middlesex county; Belmont Natural Spring, Belmont, Middlesex county; Everett Crystal Spring, Everett, Middlesex county; Sheep Rock Spring, Towell, Middlesex county; Simpson Spring, South Easton, Bristol county; Undine Spring, Brighton, Suffolk county; Commonwealth Mineral Spring, Waltham, Middlesex county.

Michigan.—1889.—Although but one spring reported sales in 1888 there were seven reporting in 1889. They are the following: Americanus Well, Lansing, Ingham county; Eastman Springs, Benton Harbor, Berrien county; Magnetic Mineral Springs, Spring Lake, Ottawa county; Mount Clemens Original Mineral Springs, Mount Clemens, Macomb county; Salutaris Mineral Spring, Saint Clair Springs, Saint Clair county; Ypsilanti Mineral Spring, Ypsilanti, Washtenaw county; Zauber Wasser Spring, Hudson, Lenawee county.

1890.—There is no change in the list for 1890, but one of the springs has sent no report. Those reporting are: Americanus Well, Lansing, Ingham county; Eastman Springs, Benton Harbor, Berrien county; Magnetic Mineral Springs, Spring Lake, Ottawa county; Mount Clemens Original Mineral Springs, Mount Clemens, Macomb county; Salutaris Mineral Spring, Saint Clair, St. Clair county; Zauber Wasser Spring, Hudson, Lenawee county.

Minnesota.—1889.—The only spring reporting for this State in 1889 and 1890 is Inglewood Springs, Hennepin county.

Mississippi.—1889.—Instead of three springs, as in 1888, only the following two report for 1889: Brown's Wells, Copiah county, S. J. Morehead, Brown's Wells post-office; Castilian Springs, near Durant, Holmes county. The same two wells report for 1890.

Missouri.—The six springs of 1888 have more than doubled in 1889, thirteen springs reporting, as follows: Artesian White Sulphur Well, Clinton, Henry county; B. B. Spring, Bowling Green, Pike county; Blue Lick Springs, Saline county; Eldorado Springs, Eldorado Springs, Cedar county; Electric Springs, Johnson county; Haupt's Mineral Spring, Milan, Sullivan county; Lebanon Magnetic Spring, Laclede county; Paris Springs, Paris Springs, Lawrence county; Randolph Springs, Randolph Springs, Randolph county; Reed Springs, Clay county; Reiger Mineral Springs, Mercer county; Sweet Springs, Sweet Springs, Saline county; Young's Medical Well, corner Twenty-fifth and Vine streets, Kansas City, Jackson county.

1890.—Three springs are taken from the list and seven springs have sent returns, viz, B. B. Spring, Bowling Green, Pike county; Blue Lick Spring, Saline county; Eldorado Springs, Eldorado Springs, Cedar county; Paris Springs, Paris Springs, Lawrence county; Randolph Springs, Randolph Springs, Randolph county; Reiger Springs, Mercer county; Young's Medical Well, Warrensburg, Jackson county.

Nebraska.—1889.—The Victoria Mineral Spring, Custer county, represents Nebraska for the first time on the list.

1890.—Nebraska is still represented on the list by the Victoria Mineral Spring, Custer county.

New Hampshire.—1889.—Two springs report, viz: Londonderry Lithia Spring, Nashua, Rockingham county, and Milford Springs, Amherst Station, Hillsboro county.

1890.—Three springs report sales, namely, Londonderry Lithia Springs, Londonderry, Rockingham county; Milford Springs, Amherst

Station, Hillsboro county; White Mountain Springs, Conway, Carroll county.

New Jersey.—1889.—New Jersey for the first time is put upon the list with one commercial water, viz: that from Kalium Springs, Collingswood, Camden county.

1890.—No reports have been received from New Jersey.

New Mexico.—1889.—Four springs make up New Mexico's list for 1889 instead of one, as in the previous year. The springs reporting are: Aztec Springs, Santa Fé, Santa Fé county; Baca Springs, Coyote district, Bernalillo county; Ojo Caliente Springs, Ojo Caliente, Taos county; Soda Springs, near Albuquerque, Bernalillo county.

1890.—The list remains the same as for 1889, and the following three are the only springs reporting: Aztec Springs, Santa Fé, Santa Fé county; Ojo Caliente Springs, Ojo Caliente, Taos county; Soda Springs, Coyote Cañon, Bernalillo county.

New York.—1889.—Twenty-one springs made reports as compared with seventeen in 1888. The springs reporting are: Crystal Springs, Barrington, Yates county; Deep Rock Springs, Oswego City, Oswego county; Empire Seneca Springs, Dunkirk, Chautauqua county; Geneva Magnetic Mineral Springs, Geneva, Ontario county; Massena Springs, Massena, St. Lawrence county; Oneita Springs, Utica, Oneida County; White Sulphur Springs, Sharon Springs, Schoharie county.

Saratoga Springs, Saratoga county: Champion Springs, Columbia Springs, Congress Springs, Empire Springs, Excelsior and Union Springs, Hathorn Springs, High Rock Springs, Imperial Spring, New Putnam Spring, Royal or New Putnam Spring, Patterson Spring, Saratoga Carlsbad Spring, Saratoga Magnetic and Peerless Springs, Saratoga Vichy Springs.

1890.—Nineteen of the twenty-six springs on the list for New York send returns; five of these are new to the list for 1890, and one of the springs of 1889 is taken from the list. The list reporting for 1890 is: Cayuga Springs, Cayuga, Cayuga county; Deep Rock Springs, Oswego, Oswego county; Miller's Geneva Mineral Spring, Geneva, Ontario county; Massena Springs, Massena, St. Lawrence county; White Sulphur Springs, Sharon Springs, Schoharie county; Artesian Lithia Springs, Ballston Spa, Saratoga county; White Sulphur Spring, Richfield Springs, Otsego county; Avon Spring, Avon, Livingston county; Oak Orchard Acid Springs, Alabama, Genesee county.

Saratoga Springs, Saratoga county: Empire Springs, Excelsior and Union Spring, Hathorn Springs, High Rock Spring, Imperial Spring, Royal or New Putnam Spring, Saratoga Carlsbad Spring, Saratoga Vichy Springs, Saratoga Kissingen Spring.

North Carolina.—1889.—The six springs on the list for 1888 have increased to the following eleven: All-Healing Spring, Alexander county; Ashley's Bromine and Arsenic Springs, Ashe county; Barium Springs, Barium Springs, Iredell county; Black Mountain Iron and Alum

Springs, Black Mountain, Buncombe county; Lemon Springs, Lemon Springs, Moore county; Lincoln Lithia Springs, Lincolnton, Lincoln county; Minnekahta Springs, Gaston county; Panacea Springs, near Littleton, Halifax county; Park's Alkaline Springs (near Danville, Va.), Caswell county; Seven Springs, Seven Springs, Wayne county; Shaw's Healing Springs, Littleton, Halifax county.

1890.—One new spring is added to the list and one is taken from it. Only the following six report, viz: Ashley's Bromine and Arsenic Springs, Bristol, Ashe county; Barium Springs, Barium, Iredell county; Lemon Springs, Lemon Springs, Moore county; Lincoln Lithia Springs, Lincolnton, Lincoln county; Park's Alkaline Springs, Caswell county (post-office Danville, Virginia); Thomson's Bromine Arsenic Spring, Crumpler, Ashe county.

Ohio.—1889.—The seven springs of 1888 have increased to eleven, from all of which reports have been received. They are: Adams County Mineral Spring, Mineral Springs, Adams county; Belbrook Magnetic Springs, Belbrook, Greene county; Crystal Mineral Spring, Urbana, Champaign county; Devonian Mineral Spring, Lorain, Lorain county; Electro-Magnetic Springs, Fountain Park, Champaign county; Lenape Spring, Delaware, Delaware county; Magnetic and Saline Spring, Marysville, Union county; Ohio Magnetic Springs, Magnetic Springs, Union county; Rex Mineral Water, New Richmond, Clermont county; Ripley Bromo-Lithia Spring, Ripley, Brown county; Sulphur Lick Spring, Frankford, Ross county.

1890.—One spring is taken from the list and one added, which leaves the total the same as for 1889. Only eight springs have reported, viz: Adams County Mineral Spring, Mineral Springs, Adams county; Crystal Mineral Spring, Urbana, Champaign county; Devonian Mineral Spring, Lorain, Lorain county; Electro-Magnetic Springs, Fountain Park, Champaign county; Rex Mineral Spring, New Richmond, Clermont county; Ripley Bromo-Lithia Spring, Ripley, Brown county; Sulphur Lick Spring, Anderson, Ross county; Magnetic and Saline Spring, Marysville, Union county.

Oregon.—1889.—The following report: Wagner Soda Spring, Ashland, Jackson county; Wilhoit Spring, Clackamas county.

1890.—No reports have been received from Oregon.

Pennsylvania.—1889.—The three springs of the list for 1888 have increased to twelve. They are: Allegheny Spring, Warren county; Bedford Springs, Bedford, Bedford county; Black Barren Mineral Spring, Pleasant Grove, Lancaster county; Corry Artesian Fountain, Corry, Erie county; Cresson Springs, Cresson, Cambria county; Eureka Mineral Springs, Saegerstown, Crawford county; Parker Magnetic Mineral Springs, Gardeau, McKean county; Pavilion Springs, Wernersville, Berks county; Pulaski Mineral Spring, Pulaski, Lawrence county; Roscommon Springs, Wind Gap, Monroe county; Sizerville Magnetic Mineral Spring, Sizerville, Cameron county; Susquehanna Spring and Kingsland Spring, Rush, Susquehanna county.

1890.—One spring is taken from the list and ten springs report sales, These springs are: Black Barren Mineral Spring, Pleasant Grove. Lancaster county; Corry Artesian Fountain, Corry, Erie county; Cresson Springs, Cresson, Cambria county; Eureka Mineral Springs, Saegerstown, Crawford county; Parker Magnetic Mineral Spring, Gardeau, McKean county; Pavilion Springs, Reading, Berks county; Pulaski Mineral Springs, Pulaski, Lawrence county; Roscommon Springs, Wind Gap, Monroe county; Sizerville Magnetic Mineral Spring, Sizerville, Cameron county; Susquehanna Spring and Kingsland Spring, Rush, Susquehanna county.

Rhode Island.—1889.—Both springs on Rhode Island's list report sales. They are: Ochee Mineral and Medical Springs, Johnson, Providence county; Holly Springs, Woonsocket, Providence county.

1890.—Both localities report for this year, viz: Ochee Mineral and Medical Springs, Johnson, Providence county; Holly Springs, Woonsocket, Providence county.

South Carolina.—1889.—Two springs report sales, viz: Chick's Springs, Chicks Springs, Greenville county; Glen Springs, Glen Springs, Spartenburg county.

1890.—No reports have been received for 1890.

South Dakota.—1889.—South Dakota is represented for the first time on the list by Dakota Hot Springs, Fall River county, which reports also for 1890.

Tennessee.—1889.—Four springs, a decrease of two from 1888, report. They are: Estill Springs, Estill Springs, Franklin county; Idaho Springs, near Clarksville, Montgomery county; Red Boiling Springs, Red Boiling Springs, Macon county; Rhea Springs, Rhea Springs, Rhea county.

1890.—Only one of the springs on the list of 1889 has reported: Idaho Springs, Clarksville, Montgomery county; and one, new to the list, reports sales, viz: Tate Spring, Tate Spring, Grainger county.

Texas.—1889.—The number of springs reporting in 1889 is fourteen, just double the number for 1888. They are: Capp's Well, Longview, Gregg county; Dalby Springs, Texarkana, Bowie county; Elkhart Mineral Well, near Elkhart, Anderson county; Hynson's Iron Mountain Springs, Marshall, Harrison county; Mineral Wells Springs, Mineral Wells, Palo Pinto county; Montvale Springs, Marshall, Harrison county; Overall Mineral Well, Franklin, Robertson county; Page's Well, Georgetown, Williamson county; Richards's Wells, Rockdale, Milam county; Rosborough Springs, Marshall, Harrison county; Slack's Well, Fayette county; Texas Sour Springs, Luling, Caldwell county; Tioga Mineral Well, Tioga, Grayson county; Wooten Wells, Robertson county.

1890.—Thirteen springs report sales. They are: Capp's Well, Longview, Gregg county; Dalby Springs, Dalby Springs, Bowie county; Elkhart Mineral Well, Elkhart, Anderson county; Hynson's Iron Mountain Spring, Marshall, Harrison county; Mineral Well Springs, Mineral Wells, Palo Pinto county; Montvale Springs, Marshall, Harrison county; Overall Mineral Well, Franklin, Robertson county; Richards' Wells, Rockdale, Milam county; Rosborough Springs, Marshall, Harrison county; Slack's Well, Fayette county (post-office, Walder Depot, Gonzales county); Texas Sour Springs, Luling, Caldwell county; Tioga Mineral Well, Tioga, Grayson county; Wooten Wells, Robertson county.

Vermont.—1889.—The list of springs decreased from six in 1888 to three, as follows: Alburg Sulphur and Lithia Springs, Alburg Springs, Grand Isle county; Brunswick White Sulphur Springs, Brunswick, Essex county; Clarendon Springs, Clarendon Springs, Rutland county.

1890.—One new spring is added to the list, making the total four for the State, all reporting, as follows: Alburg Sulphur and Lithia Springs, Alburg Springs, Grande Isle county; Brunswick White Sulphur Spring, Brunswick, Essex county; Clarendon Springs, Clarendon, Rutland county; Missisquoi Springs, Sheldon, Franklin county.

Virginia.—1889.—Twenty-one springs reported sales. The following is the list: Bear Lithia Springs, Elkton, Rockingham county; Blue Ridge Springs, Blue Ride Springs, Botetourt county; Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg county; Cove Lithia Water, Wytheville, Wythe county; Farmville Lithia Springs, Farmville, Prince Edward county; Hot Springs, Hot Springs, Bath county; Hunter's Pulaski Alum Springs, Walker's Creek, Pulaski county; Jordan White Sulphur Springs, Jordan Springs, Frederick county; Massanetta Springs, Massanetta Springs, Rockingham county; Osceola Springs, near Pleasant Valley, Rockingham county; Otterburn Lithia and Magnesia Springs, Amelia C. H., Amelia county; Pæonian Spring, Loudoun county; Powhatan Lithia and Alum Spring, Powhatân, Powhatan county; Rawley Springs, Rawley Springs, Rockingham county; Roanoke Red Sulphur Springs, Roanoke county; Rockbridge Alum Springs, Alum Springs, Rockbridge county; Rockingham Springs, McGaheysville, Rockingham county; Seven Springs, 2 miles northwest of Glade Springs, Washington county; Stribling Springs, Stribling Springs, Augusta county; Virginia Arsenic Bromine and Lithia Springs, near Allegheny Springs, Montgomery county; Wallawhatoola Alum Springs, Millboro Springs, Bath county; Wolf Trap Lithia Springs, Wolf Trap Station, Halifax county.

1890.—By the addition of two new springs the list is increased to twenty-three, and the following twenty report: Blue Ridge Springs, Blue Ridge Springs, Botetourt county; Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg county; Cove Lithia Springs, Wytheville, Wythe county; Elk Lithia Spring, Elkton, Rockingham county; Farmville Lithia Springs, Farmville, Cumberland county; Hunter's Pulaski Alum Springs, Walkers Creek, Pulaski county; Jordon White Sulphur Springs, Stephenson, Frederick county; Massanetta Springs, near Harrisonburg, Rockingham county; Osceola Springs, Harrisonburg, Rockingham county; Otterburn Lithia and Magnesia Spring, Amelia C. H., Amelia county; Pæonian Spring, Clarks Gap, Loudoun county; Roanoke Red Sulphur Springs, Catawba, Roanoke county; Rockbridge Alum Springs, Goshen, Rockbridge county; Rockingham Springs, McGaheysville, Rockingham county; Seven Springs, Abingdon, Washington county; Stribling Springs, Stribling Springs, Augusta county; Virginia Arsenic, Bromine, and Lithia Springs, Christiansburg, Montgomery county; Wallawhatoola Alum Springs, Richmond, Bath county; Wolf Trap Lithia Springs, Wolf Trap Station, Halifax county; Shenandoah Alum Springs, Mount Jackson, Shenandoah county.

Washington.—1889.—The State of Washington presents a list of three instead of one as in 1888. The springs reporting are: Cascade Springs, Skamania county; Medical Lake, Medical Lake, Spokane county; Yakima Soda Springs, North Yakima, Yakima county.

1890.—Two springs report as follows: Medical Lake, Medical Lake, Spokane county; Yakima Soda Springs, North Yakima, Yakima county.

West Virginia.—1889.—Four springs report for 1889, as follows: Capon Springs, Capon Springs, Hampshire county; Salt Sulphur Springs, Salt Sulphur Springs, Monroe county; Triplett Springs, Willow Island, Pleasant county; White Sulphur Springs, White Sulphur Springs, Greenbrier county.

1890.—Two springs are added to the list and the total number report. They are Red Sulphur Springs, Monroe county; Irondale Springs, Independence, Preston county; Triplett Springs, Willow Island, Pleasant county; White Sulphur Springs, White Sulphur Springs, Greenbrier county; Capon Springs, Capon Springs, Hampshire county; Salt Sulphur Springs, Salt Sulphur Springs, Monroe county.

Wisconsin.—1889.—Twenty springs report in this year as compared with the twelve in the list of 1888. The springs reported are: Allouez Magnesia Mineral Spring, Green Bay, Brown county; Ashland Mineral Spring, Ashland, Ashland county; Darlington Mineral Spring, Darlington, Lafayette county; Fort Crawford Spring, Prairie du Chien, Crawford county; Lebens Wasser Spring, Brown county; Salvator Mineral Spring, Brown county; Shealtiel Springs, Waupaca, Waupaca county; Sheboygan Springs, Sheboygan, Sheboygan county; Silver Sand Spring, Milwaukee county; Vita Mineral Spring, Beaver Dam, Dodge county; Nee-Ska-Ra Spring, Milwaukee, Milwaukee county.

Waukesha Springs, Waukesha county: The Alma Spring, Arcadian Mineral Spring, Bethesda Mineral Springs, Clysmic Springs, Henk Mineral Springs, Horeb Mineral Spring, Mineral Rock Spring, Waukesha Hygeia Mineral Spring, White Rock Mineral Spring.

1890.—Two springs are added to the list, and the name of the Alma Springs at Waukesha is changed to Almanaris. The following twelve springs report sales: Allouez Magnesia Mineral Spring, Green Bay, Brown county; Darlington Mineral Spring, Darlington, Lafayette county; Fort Crawford Spring, Prairie du Chien, Crawford county;

Lebens Wasser Spring, Green Bay, Brown county; Salvator Mineral Spring, Green Bay, Brown county; Shealtiel Mineral Spring, Farmington, Waupaca county; Sheboygan Springs, Sheboygan, Sheboygan county; Silver Sand Spring, Milwaukee, Milwaukee county; Nee-Ska-Ra Spring, Wauwatosa, Milwaukee county; Palmyra Springs, Palmyra, Jefferson county; Rainbow Mineral Spring, Wautoma, Waushara county; Vita Mineral Spring, Beaver Dam, Dodge county; Bethania Mineral Springs, Osceola Mills, Polk county.

***Waukesha Springs, Waukesha county.*—Almanaris Spring, Arcadian Spring, Bethesda Mineral Spring, Henk Mineral Spring; Hygeia Mineral Spring; Mineral Rock Spring, White Rock Mineral Spring.**

Summary of reports of mineral springs for 1890.

	Springs reporting.	Springs not reporting.	Total used commercially.		Springs reporting.	Springs not reporting.	Total used commercially.
North Atlantic States:							
Maine	7	3	10	North Central States:			
New Hampshire	3	0	3	Ohio	8	3	11
Vermont	4	0	4	Indiana	8	0	8
Massachusetts	8	1	9	Illinois	7	2	9
Rhode Island	2	0	2	Michigan	6	1	7
Connecticut	2	1	3	Wisconsin	20	3	23
New York	19	7	26	Minnesota	1	0	1
New Jersey	0	1	1	Iowa	5	1	6
Pennsylvania	10	1	11	Missouri	7	3	10
South Atlantic States:				North Dakota	0	0	0
Delaware	0	0	0	South Dakota	1	0	1
Maryland	2	2	4	Nebraska	1	0	1
District of Columbia	0	0	0	Kansas	7	1	8
Virginia	20	3	23	Western States and Territories:			
West Virginia	6	0	6				
North Carolina	6	5	11	Alaska	0	0	0
South Carolina	0	2	2	Wyoming	0	0	0
Georgia	4	0	4	Montana	0	0	0
Florida	1	0	1	Colorado	7	1	8
South Central States:				New Mexico	3	1	4
Kentucky	5	0	5	Arizona	0	0	0
Tennessee	2	3	5	Utah	0	0	0
Alabama	3	2	5	Nevada	0	0	0
Mississippi	2	0	2	Idaho	1	0	1
Louisiana	0	0	0	Washington	2	1	3
Texas	13	1	14	Oregon	0	2	2
Indian Territory	0	0	0	California	12	2	14
Oklahoma	0	0	0				
Arkansas	5	0	5	Total	220	53	273

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Abbott quicksilver mine, California	389	494	286	161	119	98	95
Abrasive materials	476	712	428	581	552	576	456
buhrstone	477	712	428	581	552	576	456
corundum	476	714, 733	429	585	553	577	457
emery	476	714	431	586	554	577	457
grindstones	479	713	428	582	552	545, 576	458
imports	476	718, 719	428, 432	582, 586	552	576	456
infusorial earth	479	720	433	587	554	578	459
novaculite	492		433	589	4, 7	5	460
pumice stone	480	721	433				
rotten stone		722					
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Accidents in coal mining	107	126	27	254	225	255, 299, 387, 389	205
Actinolite		382, 765			785		
Afghanistan, petroleum		232					
Africa, copper		355	229, 242	129, 139	88	73	73
gold		319					
iron ore				98, 102			
Agalmatolite, North Carolina	713				769		
Agate	491	756, 781	441, 443	597, 604	556, 561	584	446
in Arizona		757			561		
Arkansas		757			700		
California		757		597	704		
Colorado	491	757					
Connecticut	672	756			714		
Illinois		757					
Lake Superior region	491	757					
Massachusetts	694	756			743		
Minnesota		757					
New York		756	442				
North Carolina	713	757			769		
Oregon		757					
Rhode Island	727				785		
Texas	734	757			793		
Washington			441				
Wisconsin		757					
Yellowstone National Park		757					
Agatized wood	492	759		596	561	581	446
Alabama, alum		949		681			
asbestos	669		521		693		
asphaltum						513	
barytes	669				693		
blast furnaces	121				20		
brick production					535, 537	557, 565	
buhrstones		712					
cassiterite	667, 669	767			693		
chalcopyrite	669				693		
clay	667	678			690		
coal	6, 34, 36, 667	12, 14, 156	11, 13, 83	230, 235	171, 189, 205, 690	171, 206, 208	146, 172
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coke	98	145, 149	75, 85	378, 389	22, 383, 394	4, 395, 406	
copper	231, 669				693		
corundum	669				553, 693		
covellite	669				693		

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Alabama, fire brick and clay	466	678			541, 690	564, 570	
flagging stone	667				690		
galena	669				694		
gold	176, 179. 667				691, 694	37	49
granite	667				515, 691	521	
graphite	590, 667			686	691		
grindstone					693, 694		
gypsum	526	809			694		
halloysite	667				691		
hematite	149, 667, 668	278		85	691, 692, 694		40
iron	119, 133, 149, 160	252	182	18, 83, 85	11	14, 23	10, 17
ores	149, 156	278		86, 88, 91	49, 694	17	24, 40
kaolin	668			573	691	572	
lead ore					694		
lignite	669				694		
lime					582		
limestone						521	373, 377
limonite	149, 668			85	691		
lithographic stone	595	935					
magnetite	149, 669	278		85	694		
manganese	669	552	345		694		
marble	668			543	692	542	
marls	523, 668	808	454, 464	619	592	505	
melaconite	670				694		
menaccanite	149						
metallic paint				711			510
mica	670	908			671, 693, 694		
millstones and grindstones	669						
mineral waters		979	536	715	683	626, 630	522
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nails	125		186				
natural gas		236, 243	161		494		
ocher		926			693		508
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phosphate rock		783, 794 803	464	618	584, 694		
phosphatic greensand		798, 801					
pottery						572	
pyrites	150, 670		506		695		
pyrolusite	669, 670				695		
pyrrhotite					695		
quartz	670				695		
sandstone	669				693, 695	521	374, 377
siderite	670				695		
silver	176			105	59	37	49
slate					695		
sphalerite	670				695		
steel	137			18		14	
structural materials					507	521	
talc	669	601			693		
tin ore	669				693		
zinc blende	670				695		
Alabandite, Colorado		814			712		
Alabaster and spar ornaments	762		464		602		
Arizona	762				698		
California	768				704		
Utah	775	780			796		
Alaska, amber							
antimony ores					695		
argentite					695		
asbestos					696		
berthierite		655			695		
bismuth							
calcite	760				696		
chalcopyrite	760	17			696		
coal	760		14		695	214	
copper	760				695		
galena		747			695		
garnet		312			695		
gold and silver	172, 176		200	104	58, 60, 695	36	49
graphite	760				696		
jadeite	498						
lead					695		
lignite	760				695	214	
limestone	760	665			696		
marble		911					
mica	584	979			696		
mineral waters						630	

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Russian-American Coal Co						215	
silver	172, 176, 179		200	105	59, 695	36	49
sphalerite					695		
sulphur		867					
tetrahedrite					695		
Alaskaite, Colorado	748				707		
Albany, N. Y., structural materials				523		529	
Albite					562		
Connecticut					714		
Pennsylvania	725				783		
Algeria, antimony		645					
copper			229	128	88	73	73
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Valley, Pa., coke district		191	107	416	418	422, 425	
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Almaden, Spain, quicksilver mine		496				105	101
Altaite, Colorado	748				707		
Altoona, Cal., quicksilver mine	389				119	98	94
Alum	606	949		681	646		
in Alabama		949		681			
Arizona	762			681	698		
California	606	949			705		
Colorado	606	949					
Georgia		949					
Indiana		949					
Nevada				681			
New Jersey	606	949		681			
New York	606						
Ohio	720	949			777		
Pennsylvania	606			681			
South Carolina				681			
Tennessee	732	949			791		
Texas		949					
Utah	775				796		
Wyoming					809		
prices				681	646		
process of preparation				682			
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shales, Texas	734				793		
Utah	775				796		
Virginia					802		
uses				682	647		
Aluminum	445	658	390	220	138	160	110
alloys		659			139	162	115
brass			391		139	162	
bronze		658	390	221	139	162	115
cap Washington Monument		659					
imports		658, 660	390, 392	221	138	162	118
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iron alloys			391			163	112
manufacture of		658			653	160	
prices	445	658	390	220	138	160	100
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steel							117
sulphate	762				698		
uses		658	390	220		160	116
Alunogen, Arizona	762				698		
Amargosa (California) Borax Co	571						
Amazon stone	495	770	443	604	556, 562	584	446
in Colorado	495	724					
Maine		770					
Massachusetts		770					
North Carolina	495				668		
production	495	781	443	604	556	584	
Amber	498	779	444	598, 605	573	583	
in Alaska		780					
Delaware	675	780			719		
Maryland		780					
Massachusetts	498, 694	779			743		
Mexico		583					
New Jersey	498, 708	779		598	762		
Amethyst	491	750, 781	443	604	556	584	446
in Arizona		751					

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Georgia	676	750			721		
Lake Superior region		751					
Maine	491	750		596			
Massachusetts					743		
Michigan	696	751			747		
Nevada		751					
New Hampshire	705	750			759		
New Jersey		751					
North Carolina		725, 752					
Pennsylvania	491, 725	750			783		
Rhode Island		750		596			
Texas	734	751			798		
Virginia	491						
Wisconsin		751					
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cannel coal, Tennessee					357		
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Nebraska					277		
New Mexico	62	56					232
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Oregon	95	66		295	280		
Pennsylvania		177, 181, 183, 190, 193	99, 104	307, 327, 330, 334	245		
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Utah	78, 81	203	117	351	359	375	
Virginia	82	205		355	365	380	
Washington	96	99, 206		359	373		
West Virginia	84	208		374, 428	379	389, 432	282, 284
Wyoming	85, 87	101		375		391	
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Illinois		162					
Indiana				396	399		
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Kentucky		166		398, 401	404	411	
Montana		169					
Ohio		172					
Pennsylvania		178, 182, 185, 187, 189, 195	103, 106, 109		413	419	
Tennessee		197	114	421			
Utah		203	117				
Virginia			118	423			
Washington						426	
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green sands, Alabama		798					
gypsum					600		
infusorial earth		721		587	554		
iridosmine		581					

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Connecticut		271					
Kentucky		279		97			
Michigan		264, 268		71	38		
Minnesota		267		77	41		
Missouri		269			47		
Montana						34	
New Jersey		275		51			
New York		272		45	43		
North Carolina		277		83			
Pennsylvania		270		53	44		
Utah		288					
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lead slags		449, 454					
limestone					588, 598		421
manganese ore		550	311, 323, 330, 334	185	148, 156	129, 132, 138	133, 171
silver ore		379					
meteoric iron		290					
natural gas		235				510	
phosphatic rock, Alabama		798, 802					
North Carolina.		790	449	616			
platinum ore		577					
salt			482	636	614, 619		
smaltite		544					
spiegel iron		561, 564					
tin ore	434	614	370, 375			146, 153	
tourmaline					560		
tungsten ore		575					
Andalusite	497	382, 741					
André, M., experiments with copper mattes.	649						
Anglesite		382			707		
in Arizona	760, 762				698		
Colorado	748				706		
Idaho	770				722		
Iowa	682				731		
Massachusetts	694				743		
Nevada	772				756		
Utah	773				794		
Wyoming					809		
Anhydrite, Arizona	762				698		
Anthracite coal	7	778, 781	443	604	556	3, 226, 302, 584	242
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Massachusetts		87			744		
New Mexico	32	56	41	288	763	298	146
Pennsylvania	7	70	45	295	290, 779	168, 302	146, 242
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West Virginia		93, 98			804		
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Antimonial lead ores	760	650			696		
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silver, Arizona	761				697		
Antimony	xiii	641	7, 387	2, 7, 9	2, 6	7, 10	141
alloys		650					
and iron sulphide					695		
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gold associated with	439	642, 646					
imports		651	387				142
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Arizona	764				700		
Arkansas	672				703		141
Austria		646					

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Italy		645					
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North Carolina	716						
Nova Scotia		645					
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Prussia		645					
Spain		645					
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Idaho					722		
Utah	774				796		
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grey	672				701, 717		
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shipments	438		387				
prices	439	651	388				142
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Apatite	521	775, 803, 805	455		594	596	454
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Canada	521	803, 805			594	596	454
Connecticut	672				714		
Kentucky	686				735		
Massachusetts	521, 694				743		
New Jersey	521, 707				761		
New York	521, 711				768		
North Carolina mica veins					668		
Pennsylvania	725				783		
production		807	457		594	596	455
Apophyllite		775					
Aquamarine	487		439	596	770		
Aragonite		728					
in California	767				703		
Dakota		777					
Iowa		777					
Wyoming					808		
Arethunite					668		
Argasoid		632					
Argentine Republic copper				128		73	73
gold		319					
silver		319					
Argentite		382					
in Alaska					695		
Arizona	760				696		
Colorado	748				707		
Idaho	770				722		
Maine	687				736, 738		
Montana	754				753		
New Mexico	756				762		
North Carolina	713						
Wyoming					809		
Arizona agate		757					
agatized wood		759		596		581	
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alum	762			681	698		
alunogen	762				698		
amethyst		751					
anglesite	760, 762				696, 698		
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silver ores	761				697		
antimony and iron sulphide					696		
ocher	763				698, 700		
sulphide	439				700		
argentite	760				696		
arsenical lead ore					697		
arsenopyrite	760				696		
asbestos	762				698		
asphaltum	762				698		

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aurichalcite	762				698		
azurite	760				696		
barnhardite	760				696		
barytes	762				698		
berthierite	760				698		
biotite	762						
bismuth	440	654			696, 700		
bitumen	762				698		
bluestone	760				696		
bornite	760				696		
breunerite	762				698		
brogniardite	760				696		
building stone	762				698		373, 378
calamine	763				698		
calcite	763				698		
caledonite	763				698		
cerargyrite	760				696		
cerussite	760				696		
cervantite	763				698		
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chalcocite	760				696		
chalcopyrite	760				696		
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chrysocolla	760	778			697		
cinnabar	763				698		
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cupola copper smelting		397					
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freieslebenite	761				697		
galena	761				697		
garnet	488, 761, 763	747			697, 699	581	
glauberite	763				699		
gold	172, 182, 763	312	200	104	58, 697, 699	36	49
granite	761				697		
graphite	761				697		
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gypsum	529, 763	813		623	698		
hausmannite	763				699		
hematite	761, 763				697, 699		
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itabiryte	763				699		
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limonite	761, 763				697, 699		
magnesite	763				699		
magnetic iron ore	761, 763				699		
malachite		777			697		
manganese ores	762				697, 699		
melaconite	761				697		
miargyrite	761				697		
mica	764	911			699		
mineral waters		979				630	

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ocher					697		
opal	764				699		
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phœnicochroite	764				699		
platinum	764	576			699		
polybasite	761				697		
proustite	761				697		
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pyrargyrite	761				697		
pyrite	761				696		
pyrolusite	762, 764				697, 699		
pyromorphite	764				699		
pyrrhotite	762				697		
quartz	762				697		
salt	550, 763	848	483		699		
sandstone	764				700		374, 378
sapphire	486						
siderite	762				697		
silver	172, 176 760, 762	312	200	104	58, 698 700	36	49
smithsonite	764				700		
sodium sulphate	763				699		
sphalerite	762				698		
stephanite	762				698		
sternbergite	762				698		
stibnite	764				700		
stromeyerite	762				698		
talc	762, 764				698, 700		
tellurium	762			648	698		
tetradymite	440				700		
tetrahedrite	762				698		
thenardite	764				700		
topaz	486						
turquois	493	767			698		
vanadate of copper	764				700		
lead	763				699		
vauquelinite	764				700		
volborthite	764				700		
volgerite	764				700		
wad	762						
willemite	764				700		
wulfenite	762, 764				698, 700		
zinc carbonate					700		
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Maine	689				738		
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Montana	754				753		
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Dakota					716		
Georgia	676				720		
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Iowa	682				731		
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Maine	580, 689				738		
Massachusetts	694				744		
Michigan	696				747		
Minnesota	697				748		
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Pennsylvania	580, 725				783		
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Virginia	580, 738	922	525	705	676, 799	6	513
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Connecticut	672	654			714		
Cornwall		655					
Germany			389				
Hungary		655					
Idaho			387				
Montana			389				
New Hampshire	705				759		
New York		654					
North Carolina		654					
South Carolina		654					
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Illinois	678				726		
Missouri	701				752		
North Carolina	716				773		
Tennessee	732				791		
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Pennsylvania					783		
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New Hampshire		551			760		
New York	713	551			769		
North Carolina		551			774		
Pennsylvania	726	551			784		
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Bornite, Arizona	760				696		
Colorado	749				707		
Connecticut	673				714		
Maine	687				736		
Maryland	690				739, 741		
Massachusetts	694						
Montana	754				753		
New Hampshire	703				757		
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Cadmium	726				752, 784		
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Cairngorm	490						
Calamine in Arizona	763				698		
Arkansas	671				700		
Connecticut	673				714		
Kansas	682				732		
Maryland	692				741		
Missouri	699				750, 753		
New Jersey	706				760		
Pennsylvania	721				783		
Tennessee	730				788		
Virginia	738				799		

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North Carolina	715			619	772		
Virginia					801		
West Virginia					805		
tufa	711				722, 768, 805		
Calcined plaster		810	461	620	595		465
Calcite		382					
in Alaska	760				696		
Arizona	763				698		
California	767			597	703		
Colorado					707		
Connecticut					714		
Idaho	770				722, 724		
Kentucky					733		
Louisiana					736		
New York	711				768		
Oregon					778		
Utah	773				794, 796		
Washington					803		
Wyoming					808		
Caledonite in Arizona	763				698		
California agate		757			704		
alabaster	768				704		
alum	606	949			705		
andalusite		742					
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borate of lime	767, 769				706		
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brick clay	767	678, 703			705	558	
buhrstones	768	712	428		704		
calcite	767				703		
carnelian					704		
cassiterite. (*See* also Tin)	768	767			705		
cement	767	675	409	564	703, 705		463
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chalk	768				705		
chiastolite	497						
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corundum	768				705		
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erubescite	768				705, 738		
erythrite	768		361		705		
feldspar	768		523		705		
fire-brick		704				566, 570	
fluorspar	768				705		
galena	767				703, 705		
garnet	768	747			705		
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gypsum	529, 769	812		623	602, 704, 706		465
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iridosmine	768		222		705		
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Connecticut	673				714		
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Colorado	749				707		
Dakota					716		
Idaho	770				722, 724		
Maine	687				738		
Montana	754	382			753		
New Mexico	756				762		
Utah	778				794		
Wyoming					808		
Cerussite		382					
in Arizona	760				696		
Colorado	749				707		
Dakota					716		
Idaho	770				722, 724		
Illinois	678				726		
Iowa	682				732		
Kansas	682				732		
Massachusetts	694				744		
Missouri	699				750		
Montana		382			754		
Nevada	772				756		
New Mexico	756				762		
New York	711				768		
North Carolina	716				773		
Pennsylvania	721				779		
Tennessee	732				791		
Utah	778				795		
Virginia	738				799		
Washington					804		
Wisconsin	747						
Wyoming					808		
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Idaho	770				722		
Utah	774				796		
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California		757					
Colorado		757					
Dakota					717		
Illinois		757					
Nevada		757					
New York		756					
North Carolina		757					
Pennsylvania		756					
Rhode Island	727				785		
Texas	734	757			793		
Utah				597			
Wisconsin		757					
Chalcocite		382					
in Arizona	760				696		
Colorado	749				708		
Connecticut	673				715		
Georgia	675				721		
Maine	687				736		
Maryland	690				739		
Minnesota	697				748		
Missouri	701				752		
Montana	754	382			754		
New Mexico	756, 758				763		
North Carolina	718				770		
Pennsylvania	725				783		
Tennessee	730				788		
Texas	735				793		
Virginia	738				799		
Wisconsin	747				807		
Wyoming	758				808		

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Alaska	760				696		
Arizona	760				696		
Arkansas	671				701		
Canada						111	
Colorado	749				708		
Connecticut	673				715		
Dakota					716		
Georgia	675				720		
Idaho	770				723		
Illinois	678				726		
Maine	687				736		
Massachusetts	694				742, 744		
Maryland	690				739, 741		
Michigan	696				747		
Minnesota	697						
Missouri	699				750		
Montana	754	382			754		
New Hampshire	703				757		
New Jersey	707				761		
New Mexico	756				763		
New York	711				768		
North Carolina	718				770		
Oregon					778		
Pennsylvania	721				779		
Rhode Island	727				785		
South Carolina	728				787		
Tennessee	730				788		
Utah	773				795		
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Virginia	739				799		
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Massachusetts	694	569			744		
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North Carolina	716	569			773		
Pennsylvania	721	567			779		
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Colorado	753				712		
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Maryland	692				741		
New Jersey	707				761		
New Mexico	756, 758				763		
North Carolina	716				773		
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Louisiana	686				736		
Maine		677					
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New Jersey	469				760		
New York	469				765	572	
North Carolina	470, 717			545	773		
Ohio	470				775		
Pennsylvania	469				780	572	
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Utah	773				795		
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North Carolina					773		
Pennsylvania	7	66	52	295	779	302	242
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galena	673				715		
garnet	673		439		715		
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Chile	252	363	234	132			
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Maine						566	
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New Jersey		697		569	540	566	
New York						566	
North Carolina						566	
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Idaho	770				723		40
Illinois	678				727		
Indiana	680				730		
Iowa	682				732		
Kentucky	684				734		40
Louisiana					736		
Maine	689				737		40
Maryland	691			77	740		40
Massachusetts	693				743		40
Michigan	696	265			746		40
Minnesota	697	266			747		39
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Nevada	772				757		
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New Jersey	706				760		39
New Mexico	147, 758	285			764		40
New York	709				766		40
North Carolina	714, 717	278			771, 774		
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Pennsylvania	723			53	780		40
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lead		434, 439					
pig iron	109		193			29	21
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granite	771				724		
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copper	678				726		
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fire clay	467, 677				725	566	
flagging stone	677				725		
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gold		321	206	108	62, 64		
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litharge		925			675	617	511
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Indiana, alum		949		681			
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brick	458	696	416		535, 537	559, 565	
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cerussite	682				732		
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Massachusetts	695		182	42	11	14	10, 17
Michigan	696	264, 267	182	62	11, 34	14, 17, 23	10, 17
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argentite	713						
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chalcocite	713				770		
chalcopyrite	713				770		
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imports			190	13	12	13, 20	
prices	142	251			14	16	
production	109, 122, 139	254	193	11	6, 14	12, 26	6, 10, 21
growth in the Southern States				33	22	24	
world's	108	257	194	22	19	29	
lead, New York City prices						83	
Pipe lines	204					447, 461	299
stone	498	778		747			446
Pitchblende	674, 752				712, 716		
Pittsburg, Kans., zinc works	347					93	
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Placer county, Cal., chromium	428						
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Platiniridium, California	769				706		
Platinum	442, 769	576	367	9, 222	142	166	143
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imports	444	578	368	223	143	167	144
in Arizona	764				699		
Australia		576					
Borneo		576					
Brazil		576					
California	442, 769	576			706		
Canada		577				165	
Colombia, United States of		576					
Colorado		576					
Georgia	442						
Hayti		576					
Idaho	442	576					
India		576					
New York	442						
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North Carolina	442, 717						
Oregon			367	222	142, 778		
Peru		576					
Ural Mountains, Russia		576	368	222	142	165	143
Virginia	442						
Wyoming			367				
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Pocahontas, Va., coal and coke			69, 118	353			
Polybasite	751, 761, 774				697, 710		
Pope Valley quicksilver mine, California	380	689		161	119		94

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clay	471				806		
Porphyry	774				697		
Porter, J. B., on Alabama iron-ore district				85			
Portland cement, American	XIII	671	405, 407	556, 560	528	552	461
Maine, structural materials				520			
Oregon, coke		206					
structural materials					510		
Portugal antimony		645					
copper	254	356, 360, 367	237	133	93	73	73
manganese		555		201			130
pyrites		358, 367, 882		656	95		
tin ore		618					
Potash, foreign sources		967					
in fertilizers			465, 470				
glass making		967	556				
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carbonate					643, 649		
chlorate					648		
chloride			465	624	637		
chromate					648		
ferricyanide					648		
ferrocyanide					648		
iodide					648		
nitrate					644, 796		
permanganate		557					
salts		816	465	624	628		
sulphate			465	625	643, 645		
Potomac marble, Maryland					742		
River cement					527	551	
Potters' clay	469, 659	676			5, 542, 728	6, 571	6
Pottery	471	689, 699	419	571	542	571	441
Pottsville, Pa., coal mining	107		46				
Prase		753					
Precious stones	XIV, 482	723	437	595	555	580	3, 6, 445
Prehnite	493						
Preston, John A., on Florida phosphates			452				
Priceite	778			222	706		505
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Proustite	751, 761, 770				697, 710, 723		
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Prussia antimony		645					
copper	255		238	135			
lead	322	437	267				
manganese				201			
nickel	410	540					
salt		849					
silver	322						
zinc ore	357	481	278				
Psilomelane		382	318, 342				
Arizona	764				699		
Arkansas	171				701		
Great Britain				199			
Montana	755				754		
North Carolina	717			192	774		
Pennsylvania	726				784		
South Carolina					787		
Vermont	738				798		
Virginia	741				802		
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California	767	721	433		706		
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auriferous	758, 770		516		724, 809		
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Spain		358, 364		655			
extraction of metals from		358	210	130	90		
foreign deposits		881	506	654			
imports	217	358, 886	211, 509	130	90, 610		
in Alabama	149, 670		506		695		
Alaska	760				696		
Arizona	761				697		
Arkansas	671				702		
California	769				706		
Canada	257	881	506	656	111	110	
Colorado	498, 751	768			711		
Connecticut	673				715		
Dakota	754				717		
Georgia	677	880	506		722		
Germany		885					
Idaho	771				723		
Illinois	679				727		
Indiana	680				730		
Kansas	684				733		
Maine	689				739		
Maryland	692				742		
Massachusetts	693	878	503	654	743		
Minnesota	698				749		
Missouri	702				753		
Montana	755				754		
Nevada	772				757		
Newfoundland	257		507				
New Hampshire	230, 706	877	501	652	760		
New Jersey	708				762		
New Mexico	757				764		
New York	712	879	504		769		
North Carolina	659, 717		505		772		
Pennsylvania	726	768			784		
Portugal	254	882	507	656	95		
South Carolina	729				787		
Spain	253	882	233, 236, 507	654	93		
Tennessee	733		506		792		
Texas	735				794		
Utah	774				795		
Vermont	736	878	502		797		
Virginia	741	879	504	653	802		
Wisconsin	747				808		
Wyoming	758				809		
nickeliferous, analyses	401			712			
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Pyrochlore					668		
Pyrolusite	425	550, 970	304, 324, 352				
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Arizona	762, 764				697, 699		
Arkansas	671				701, 702		
California	769				706		
Georgia		551			721		
Great Britain				199			
Idaho	771				724		
Maine	690				739		
Maryland	692				742		
Massachusetts	695				745		
Michigan				72			
Montana	755	382			755		
Nevada					757		
New Hampshire	706				760		
North Carolina	659, 717	552		191	774		
Pennsylvania	726				784		
South Carolina	729				787		
Tennessee					791		
Texas	736				794		
Utah	774				795		
Vermont	738		342		798		
Virginia	742		324		802		
Pyromorphite	702, 752, 764	382			699, 711, 753, 787		
Pyrope		746					
Pyroxene		382, 728		601			
Pyrrhotite		382	516			110	
Quartz	586	382		596, 604	556		446
aventurine		752					
crystals	490	724, 748			701		
gold	490	763					
in Alabama	670				695		

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Arkansas	171, 490	752			701		
California	490	749					
Colorado	490, 752	752		596	711		
Connecticut	674				714		
Dakota					718		
District of Columbia					719		
Illinois	678				726		
Indiana	680				729		
Iowa					728		
Maine	690	749			737, 739		
Maryland					740		
Massachusetts	698	751			743		
Mississippi					750		
Missouri	701	752			752		
New Hampshire	704				758		
New Jersey		752					
New York	710	748		596	767		
North Carolina	490	752			772		
Ohio	720				777		
Pennsylvania	724	752			782		
Rhode Island		728					
South Carolina					787		
Tennessee	733				792		
Vermont	738				798		
Virginia	743			596	803		
West Virginia	744				805		
Wisconsin	747				808		
Wyoming					809		
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rose	490	752			718		
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Quebec, manganese						136	130
natural gas					501		
Queensland, Australia, tin ore		620					
Quicksilver	387	492	284	160	118	97, 103	94
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foreign sources	392	496	290				
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imports		499	293	166	124	105	101
in California	387, 767	492	284	160	704	97	94
Oregon					125, 778	98	94
Utah				168			
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California	389, 393	492, 494, 496	284, 286, 288	167	120	2, 97, 100	103
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Oregon					125	98	
Spain	393	496				105	
Russia						105	
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corundum				585			
graphite				686			
grindstones				582			
salt				628	611	597	482
Randol, J. B., statistics of quicksilver	389	493		167			100
Ransome process for cement				560	530		
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Red lead	763	924	556	703	675	616	511
Reynoldsville-Walston, Pa., coke district			75, 108	416	418	423	
Rhenish provinces, Germany, zinc	356	485	277	159	117	96	92
Rhode Island, actinolite					785		
agate	727				785		
amethyst		750					
anthracite coal	7, 32	87		2, 224	785		
arsenopyrite	727						

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bog iron ore	727				785		
manganese	727				786		
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brick					536, 539		
chalcedony	727				785		
chalcopyrite	727				785		
clay	727				785		
coal	6, 727	12, 87	11	2, 224	171, 351, 785	171, 206, 361	
copper pyrites	727				785		
crocidolite		775					
dolomite					785		
fertilizers			469	625			
flagging stone	727				785		
galena	727				785		
garnet					785		
granite	727			537	513, 785	536	374, 427
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hematite	727			43	785		
hornblende	491						
ilvaite		768			785		
iron	125, 133		184	42		14	
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jasper		762			785		
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limonite	727				785		
magnetic iron ore	727			42	785		
manganese	727	551	342				
menaccanite			441				
mineral waters		984	540	718	685	628, 630	522
mispickel	727						
molybdenite	727				786		
octahedrite		772					
quartz		728, 749					
rhodonite		766					
sandstone	727						374, 428
serpentine	727				786		
sphalerite	727						
steel				17	11	14	
structural materials				523		533	
talc	727				786		
thetis hair stone	491						
wad	727				786		
whetstone	727				786		
Rhodochrosite	774	382					
Rhodonite	496, 755	382, 766	337		562, 755	582	
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Kansas					608, 732	608	
Louisiana	564			636	736	604	
Michigan	696				746		
Nevada	543			638			
New York					765		
Texas					792		
Utah	774			639	796	605	
soap, California	767				704		
Rogers, H. D., on Ohio coal		59					
Rogersite in North Carolina					668		
Roofing tile		697	422	574	549		
Rose quartz	490				718		
Rothwell, R. P., on pyrites				650			
Rottenstone, imports		722					
Roumania petroleum		232					
Rubellite					560		
Ruby	485		439	601			
artificial				601			
in Burmah					572	582	
Dakota					718		
Georgia					722		
New Jersey	485						
North Carolina	485						
silver, Arizona	761						
Colorado	751						

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Montana	755						
New Mexico	757						
Utah	774						
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Russia chrome iron ore	428	571	358			120	
coal	5, 109	13	11	235	18, 189	28, 208	
copper	257		241	128	87		73
gold		319					
iridium		581					
iron ore	109		193		18		22
lead	323	434	270				
manganese		555		204	161	141	
mining law		1002					
natural gas, Baku district		243					
petroleum		232		463, 470	458	478	
pig iron	109		193				21
platinum		576	368	222	142	165	143
quicksilver						105	
silver		319					
steel				21	18		21
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Sagenitic rutile	491	781	443	604	556	584	446
St. Joseph, Mo., structural materials						528	
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structural materials				533		528	
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history	560						
imports	549, 551	850	481, 484	640	611, 623	610	489
in Arizona	550, 763	848	483		699		
Arkansas	671	843			702		
California	532, 547, 767	845	480	628	611, 622, 704	597, 605	482, 489
Colorado	541	843					
Dakota	541						
Idaho	550, 771	848	484		724		
Illinois	678	842		628	611, 725	597	482
Indiana	679	842		628	611, 728	597	482
Indian Territory					730		
Kansas	532, 683	843			622, 732	597, 607	482, 488
Kentucky	532, 684	842		628	611, 734	597	482
Louisiana	532, 686	841	480	628, 636	611, 620, 736	597, 604	482, 488
Michigan	532, 696	828	474	628	611, 746	597	482, 483
Minnesota					748		
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Nevada	532, 543, 772	847	483	628, 638	611, 756	597	482
New Mexico	542, 744, 757	843			617, 763, 804		
New York	532, 709	830	476	632	611, 765	597	482, 484
North Carolina	717	840			773		
Ohio	532, 541, 719	836	479	628	611, 618, 776	597, 604	482, 488
Oregon	550				778		
Pennsylvania	532, 723	835			780		
Tennessee	733	842		628	611, 791	597	482
Texas	532, 734	842			792		
Utah	532, 549, 759	844	483	628, 639	611, 622, 795	597, 605	482, 489
Virginia	532, 740	840		628	611, 800	597	482

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Wyoming					809		
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Saltpeter	597				644		
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Illinois	679				727		
Indiana	681				730		
Kentucky	686				735		
Missouri	702				753		
Tennessee	733				791		
Texas	735				794		
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Alabama					696		
Illinois	678				726		
Indiana					729		
Massachusetts	693				743		
Mississippi	699						
Missouri	701				752		
New York	710				767		
Ohio	720				777		
Pennsylvania	724				782		
South Carolina	729						
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Sandstone		664		546	520	544	374
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Arizona	764				700		374, 378
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Maine	688			520	737		
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Massachusetts	451, 693				521, 743		374, 402
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Vermont	738				798		374, 432
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pig iron		287					
quicksilver		501		168			99
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Sanidin in North Carolina					668		
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San Luis Obispo, Cal., chrome iron ore	428					119	
Saponite	475, 767				704, 810		
Sapphire	485	733, 781	439, 443	604	556, 571 576	584	446
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Colorado	486						
Georgia	677				722		
Montana	485	736					
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North Carolina	485	734					
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Colorado	753				713		
Delaware	675				719		
Georgia	677				722		
Maine	690	776					
Maryland	691	776			740		400
Massachusetts	695	776			745		
New Jersey	708	776			762		
New York	712	776			769		
North Carolina	716	776			772		
Pennsylvania	724	776			782		
Rhode Island	727				786		
Vermont	737				797		
Virginia	742				802		
Sewer pipe		698	423	576			
Shale oil		929		484			
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Sicily petroleum		232					
sulphur	578	868	500		4		515
Siderite		382					
in Alabama	670				695		
Arizona	762				697		
Arkansas	679				703		
Connecticut	674				716		
Illinois	679				727		
Indiana	681				730		
Kansas	684				733		
Kentucky	685				735		
Maryland	693				741		
Massachusetts	695				745		
Michigan	697				747		
Missouri	702				753		
New Mexico	758				765		
New York	711				767		
North Carolina	716				772		

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Pennsylvania	725				782		
South Carolna	729				787		
Tennessee	732				790		
Vermont	738				799		
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California					707		
Colorado	749				707		
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Idaho	770				722, 724		
Maine					738		
Montana	754				753		
New Mexico	756				762		
Utah	773				794		
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native	764, 770				695, 711		
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of Alabama	176			105	59	37	49
Alaska	172, 177		200	105	59, 696	36	49
Argentine Republic		319					
Arizona	172, 182, 762	312, 315	200	104	59, 701	36	49
Australia		319					
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Bolivia		319					
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California	172, 177, 182	312, 315	200	104	59	36	49
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Colorado	172, 182	312, 315, 419	200	104	59		49
Dakota	172, 177	312	200	105	59, 717	36	49
France		320					
Georgia	172, 677	313	200	105	59, 722	36	49
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Idaho	172, 182, 750	312, 315	200	105	59, 723	36	49
Italy		319					
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Maine	172, 687	312	200	104	737	36	
Maryland					734		49
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Michigan	176, 697			105	59, 746	37	49
Minnesota	698				749		
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North Carolina	172, 713	312	200	105	59, 757, 774	36	49
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Oregon	172, 176, 182	312, 315	200	105	59	36	49
Pennsylvania	726				784		
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Virginia	172, 177, 743		200	105	59, 803	36	49
Washington	172	313	200	105	59, 804	36	49
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Wyoming	176, 182		200	105	59, 809	36	49
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Arkansas	672				525, 703		376, 379
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Maryland	452, 692			550	741		376, 399
Massachusetts	452, 693				743		
Michigan	696			550	522, 746	547	376, 403
Minnesota	697				749		
Nevada					757		
New Hampshire	706				760		
New Jersey	452, 707				761	547	376, 410
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Pennsylvania	452, 725		398	550	522, 783	547	376, 424
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Texas	736				794		
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Illinois	679				727		
Iowa	682				732		
Kansas	683				733		
Maryland	692				741		
Missouri	701				752		
New Jersey	707				761		
Pennsylvania	726				784		
Tennessee	732				790		
Virginia	742				802		
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Arkansas					703		
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Connecticut					716		
Georgia					722		
Maryland	693				742		
New Hampshire	704						
North Carolina	713				769		
Rhode Island					786		

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Arizona	762				697		
Arkansas	672				703		
Connecticut	674				716		
Kansas	674				733		
Maryland					741		
Massachusetts	695				745		
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Alaska					695		
Arizona	762				698		
Arkansas	672				701		
California	769				706		
Colorado	752				711		
Connecticut	674				716		
Dakota					717		
Idaho	770				723		
Illinois	679				727		
Indiana	681				730		
Iowa	682				731		
Kansas	683				733		
Kentucky	686				735		
Maine	688				737		
Maryland	692				741		
Massachusetts	695				745		
Minnesota	698				749		
Missouri	701				752		
Montana	755				755		
Nebraska	703						
New Hampshire	706				760		
New Jersey	708				762		
New Mexico	757				764		
New York	713				769		
North Carolina	717				774		
Pennsylvania	725				784		
Rhode Island	727						
Tennessee	732				791		
Utah	774				796		
Vermont	738				799		
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Indiana				18	11	14	12
Iowa						14	
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Kentucky			186	18	11	14	12
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Maine						14	
Maryland			186			14	12
Massachusetts	120		186	17	11	14	
Michigan			186	18	11	14	12
Missouri	120		186	18	11	14	12
New Hampshire	120		186			14	
New Jersey	120		186	18	11	14	12
New York	120		186	18	11	14	12
North Carolina				18		14	
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Oregon						15	
Pennsylvania	120		186	18	11	14	12
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Spain	109	257		21	18	29	21
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Tennessee	119, 135		186	18	11	14	
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Connecticut	674				716		
Dakota					718		
Georgia	677		585		722		
Maine	689				738		
Maryland	693				742		
Massachusetts	695				745		
New Hampshire	704				758		
New Jersey	708				762		
New York	711		534		768		476
North Carolina	660, 715				772		
Pennsylvania	585, 725				783		
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